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SKYLAB EXPERIENCE BULLETIN NO. 6

SPACE GARMENTS FOR IVA WEAR

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National Aeronautics and Space Administration

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AUGUST 1974

MAN-MACHINE ENGINEERING DATA APPLICATIONS
OF
SKYLAB EXPERIMENTS M487/M516

BULLETIN NO. 6

SPACE GARMENTS FOR IVA WEAR

This document is the sixth in a series of releases which are intended to make available to NASA and contractor personnel those results from the Skylab Man-Machine Engineering Experiments which have design and requirements relevance to current projects and programs. This method of data distribution has been instituted as a convenient way to provide early access to Skylab experience and is intended as an interim measure, to be followed up by a thorough experiment report six to nine months after receipt of all Skylab flight data.

PREPARED BY: Jeri W. Brown

REVIEWED AND APPROVED BY:

Robert L. Bond
Head, Man-Machine
Engineering Section

G. C. Franklin
Chief, Crew Station
Design Branch

C. C. Johnson
Chief, Spacecraft
Design Division

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SPACE GARMENTS FOR IVA WEAR

SUMMARY

In space, garments are a basic necessity to provide crewmen with thermal comfort and support for almost all of their activities. Overall, the Skylab garment design, which was generally well accepted by all the crewmen, is recognized as a major contributor to their overall efficiency and well-being, while also adding to the general habitability of the spacecraft.

Some of the more important lessons gained in the area of garment design and use through Skylab experience include the following:

- Personal preferences and style--as demonstrated by the varying frequencies of change, modes of dress and selection/use of garment options--are an integral part of the garment system. These factors should be considered along with function and system integration when designing future garment systems.
- Daily changes of underclothing is highly recommended, with less frequent change suggested for outer wear.
- Pockets should receive a greater level of attention in the design/development phases.
- Body changes in zero-g must be considered to ensure satisfactory fit.
- Greater emphasis must be placed on developing footwear to withstand the rigors of crew use.
- Garments made of absorbent material and worn in spacecraft having limited stowage/trash disposal facilities should be considered for a second role as housekeeping rags prior to final discarding.
- Maximum use of standard-size, off-the-shelf clothing for items such as underwear, will minimize cost and broaden the population of crewmembers having ready access to these garments.

In summary, in the words of one Skylab astronaut:

> Although many things in the space station operation are optimized to an unnecessary degree, the clothes are not. They are probably one of the best tools you have all day. You need the pocket just the right length and width to accommodate such items as pencils and books. The clothes for Shuttle should be designed precisely with day-to-day operations in mind. An ordinary pair of coveralls will not do. Let me give you some examples. We all wanted our scissors. Those scissors pockets were terrible. The flap didn't overlap enough, and they just had a little piece of velcro on it. Same thing with the knife pocket. Those things are important and they allow you to do the job day after day so much faster and smoothly if you have everything where you can grip it. So the Shuttle crews should have their clothes designed to suit their particular needs. They should consider what they're going to use each pocket for. That became critical as far as where the tape and your timer were. All those things should be developed first, then the clothes can be designed. They don't have to be custom made. If we had done a better job on the clothes, we could have worked faster on a day-by-day basis.*

PRE-SKYLAB EXPERIENCE

Man in space requires garments to support his well-being, comfort, and activities while inside the habitable spacecraft environment. However, because of the hostile environment outside the space vehicle, the clothing of early spaceman became life-sustaining, protecting him from the virtual absence of oxygen and intolerable temperature extremes. This life support function became the prime driver in the design of early space wardrobes.

The Mercury and Gemini garments were based on providing thermal comfort for the crewman, as well as a pressure garment for contingencies (where vehicle pressure was lost) or for extravehicular activities. Garment materials were selected on the basis of non-flammability and non-offgassing in the spacecraft environment, with little regard for crew "touch comfort." Garment quantity on board was usually limited to what the crewman wore at launch. Mercury space suits were worn from launch through recovery. Only the 14-day Gemini VII crew doffed their pressure suits while in flight. With only the pressure garment or the "long-johns" worn under it as the outer garment, little attention was paid to such

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*SL3 CDR, SL1/3 Corollary Experiments Debriefing, October 16, 1973, JSC-08482, pp. 16-17, Ref. 2.66.

characteristics as style or color.

These "neglected" characteristics received increased attention during the Apollo Program as mission length and number of crewmen increased. In the somewhat larger Apollo spacecraft, man was more mobile and performed more complex IVA tasks in the "shirtsleeve" environment he was provided. Thus, for the first time, the garment system addressed not only pressure suits for thermal and pressure protection but also specific IVA wear designed for function and crew comfort. A three-piece flight suit--consisting of jacket, trousers, and shirt--was provided for the Apollo crewman to wear when the pressure garment was not required.

By the end of the Apollo Program, space attire had progressed from archaic pressure suits to those having increased mobility and comfort for supporting extravehicular activities, complemented with shirtsleeve garments for almost all intravehicular activities.

SKYLAB DESIGN

Skylab was the first space program during which astronauts were to live in space and perform primarily intravehicular tasks. The garment design philosophy was one of providing pressure suits for extravehicular activities and informal shirtsleeve garments for intravehicular activities. Although the resulting garments did compromise crew comfort with materials requirements for the Skylab environment, crew "touch comfort" and overall appearance weighed more heavily in determining the final design. Individual garments (e.g., shirt, jacket and trousers) and removable trouser legs allowed flexibility in achieving thermal comfort across the broad range of Skylab IVA tasks. Personal preferences were allowed for items such as pocket design and underwear style. Standard-size, off-the-shelf garments had been included for the first time in a spaceman's wardrobe.

With a crew of three for a planned maximum mission length of 56 days, the cost of having reusable garments laundered in orbit--in terms of weight and volume for a washer, added water, systems hardware, etc.--was too great for Skylab. The garments were disposable.

Progressive modifications to Skylab garments in terms of quantity and design were made as experience was gained from

the first and second crews. These will be discussed in the paragraphs below and in the "Skylab Experience" section of this bulletin.

The following paragraphs describe the intravehicular garment inventory available to and used by the Skylab crewmembers.

Jacket Assembly

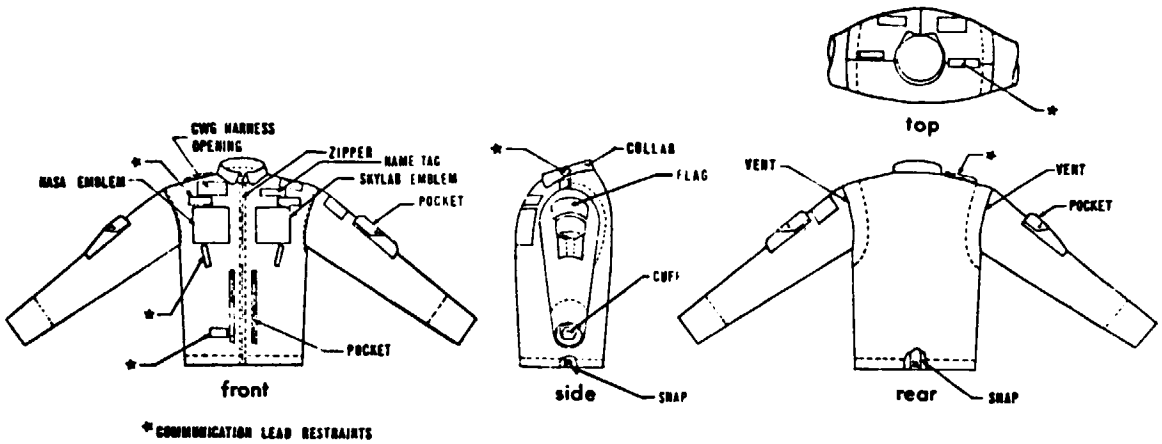
The Jacket Assembly was a contoured, custom-fit, waist-length jacket, fabricated from brown, fire-resistant woven durette fabric. The long sleeves incorporated rib-knitted durette concealed cuffs, which could be cut out during mission usage, as desired, without damage to the sleeves. Expansion vents (of spandex and durette) were incorporated into the shoulders. The jacket also featured an adjustable conformal waistband and a full collar. The waistband included three snaps which interfaced with the trouser assembly; two of these snaps also interfaced with the OWS wall snaps for temporary jacket stowage.

A front, full-length separating zipper facilitated donning and doffing. Tabs and attachment points were strategically located to restrain communication leads. Four pockets were provided on the jacket. A divided pocket, having a flap and velcro fasteners, was provided on each upper arm: the right arm pocket was designed for penlight and pens, while the left pocket was for sunglasses. Two vertical insert pockets with concealed-zipper closures were located on the front torso for stowage of miscellaneous items. Above the left arm pocket was the American flag emblem. The NASA emblem appeared on the upper right front section, while the crew emblem and name tag were located on the upper left front section.

The Jacket Assembly is shown in Figure 1. The planned jacket use rate was one per crewman per week.

Trouser Assembly

The Trouser Assembly (Figure 2), also fabricated from brown, fire-resistant woven durette material, was a custom-fit, waist-to-ankle trouser. At crew option, the trousers could be easily converted to above-the-knee shorts by unzipping a



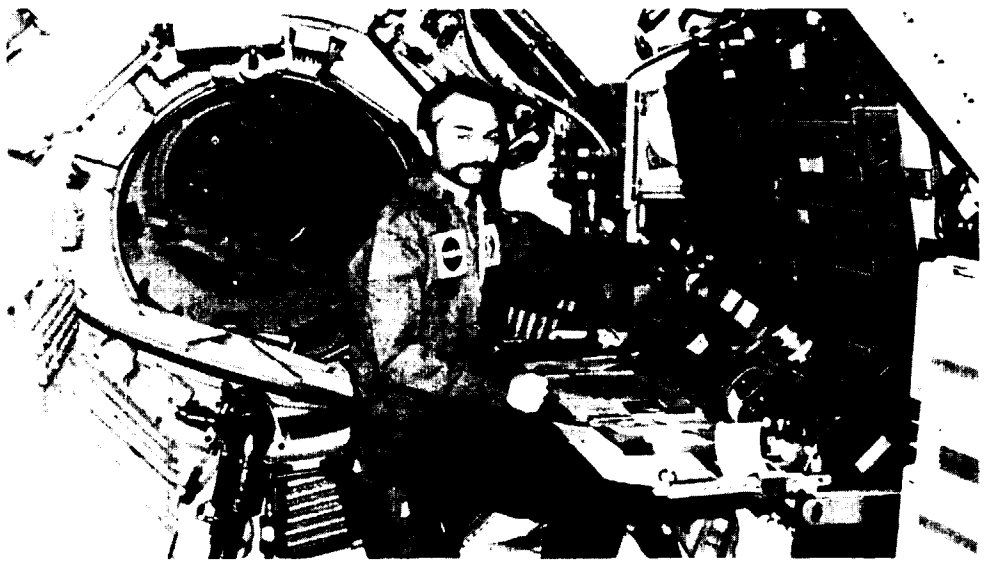
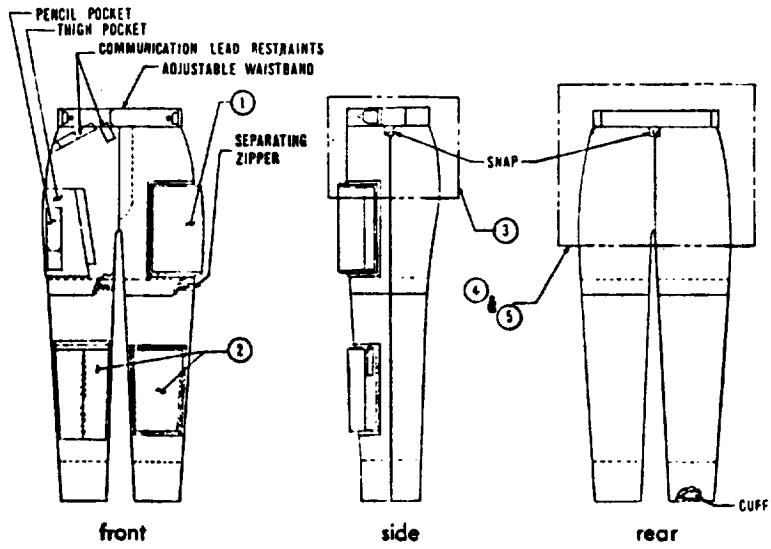


FIGURE 1: Skylab Jacket Assembly



POCKET OPTIONS:

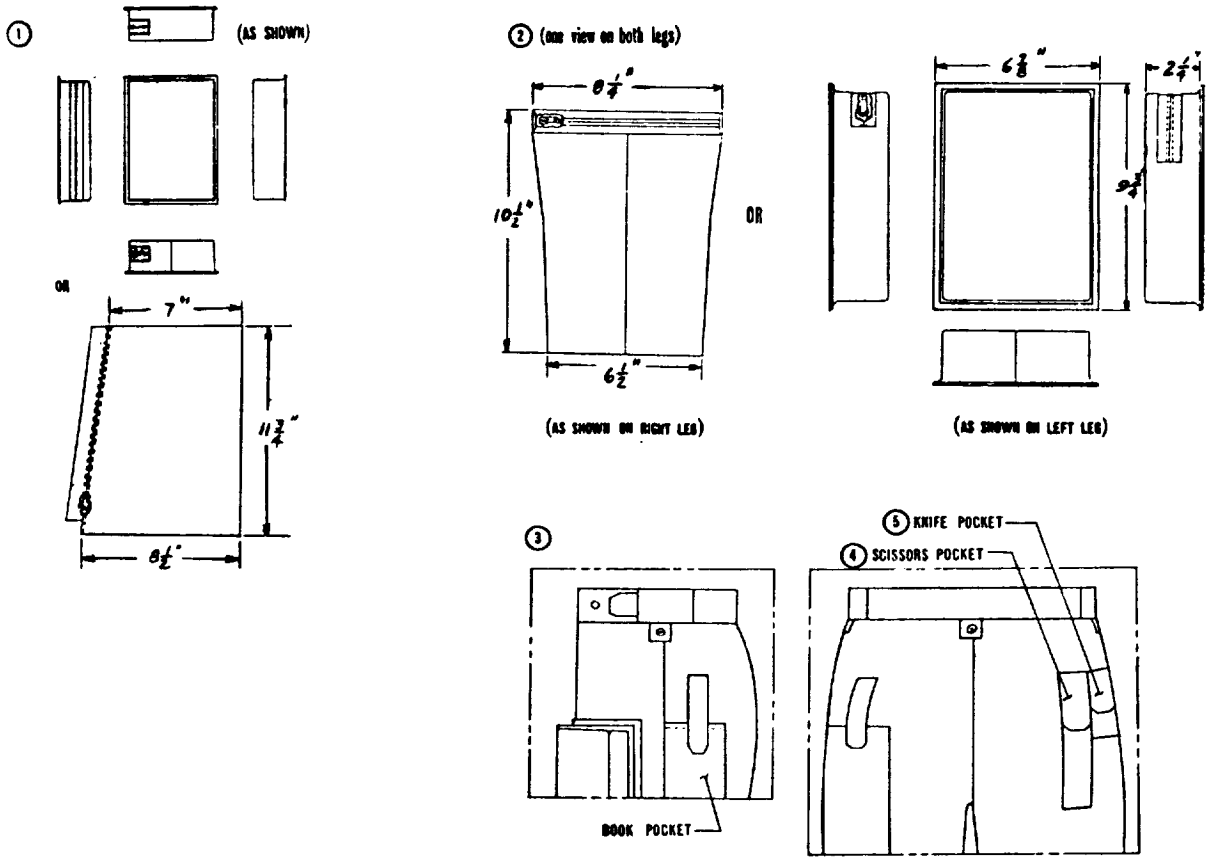


FIGURE 2: Skylab Trouser Assembly

concealed zipper and removing the lower trouser leg. As in the jacket sleeves, the legs incorporated rib-knitted durette cuffs, which could be cut out during mission usage, if a crewman desired.

The adjustable trouser waistband, providing stability and sizing comfort, had three snaps which interfaced with the Jacket Assembly (described above). One of these snaps would also interface with the OWS male wall snaps for temporary stowage. Communication lead restraints, a tab and attachment point (clamp retainer), were provided on the front of the trousers.

Four utility pockets with zippered closures were located on the front of the trousers. The right thigh pocket, a standard flush pocket, had a small pocket outside for pens/pencils. The crewman could choose either flush or box pockets for the left thigh and both leg pockets. These pockets were sized to accommodate all flight data books. The crewman could also select any or all additional pockets on the back of the trousers: book, knife, and scissors pockets. The book pocket was sized to accommodate the Teleprinter Message Book. Elastic webbing and a fold over flap were included in the top edge of the pocket to position and hold the book. The knife pocket was sized to accommodate a Swiss Army Knife. The closure on this pocket was velcro. The scissors pocket was to accommodate a Scissors Assembly, including lanyard. A velcro closure and scissors lanyard socket snap were at the top of this pocket.

Trousers were provided at the rate of one per crewman per seven days.

Shirt Assembly

Fabricated from brown, fire-resistant polybenzimidazole (PBI) or knitted durette fabric, the Shirt Assembly (Figure 3) was a shortsleeve, pullover shirt which incorporated raglan sleeves and a mock turtleneck collar. The shirt tail, a straight cut side-slit design, was to be sufficiently long to be retained under the trouser assembly waistband.

Two tabs and two attachment points on the shirt front were to serve as communication lead restraints. A zipper-closing utility pocket was located on the upper left front section. Shirts came in five sizes and were stocked on the basis of one per crewman per seven days.

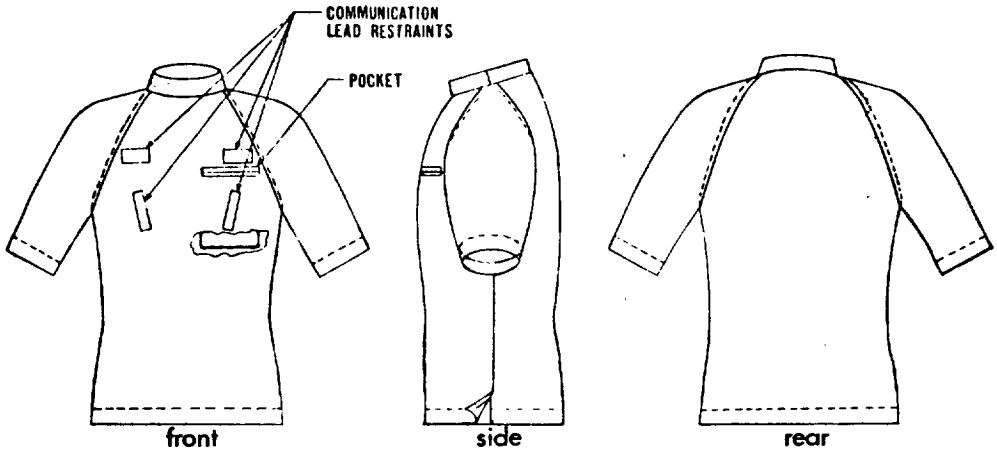


FIGURE 3: Skylab Shirt Assembly

Boot Assembly

The Boot Assembly was a lightweight pair of ankle-high boots made from woven durette for the SL2 crew and from Kevlar for the SL3 and SL4 crews. An inside-sole comfort lining of simplex knitted durette provided foot protection from tightness or material bunching. A sole stiffener and sole vents were incorporated for added comfort. A side-mounted zipper facilitated donning and doffing of the boots, which were designed to have minimum effects on crewman mobility. The Kevlar boots, which had been provided to reduce boot wear, had two-ply vamp and toe layers.

The Boot Assembly, depicted in Figure 4, came in six standard and three custom sizes. The planned use rate was one pair of boots per crewman per 14 days.

Glove Assembly

The Glove Assembly (Figure 5) was a pair of wrist-length, lightweight, five-fingered gloves. The unlined gloves were fabricated from fire-resistant simplex knitted durette, except

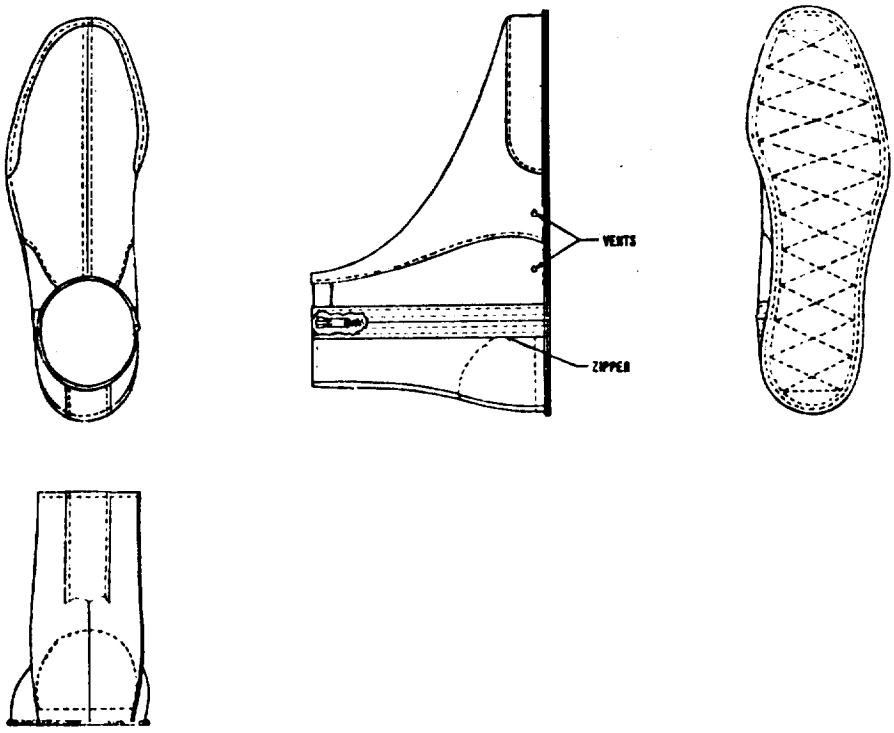


FIGURE 4: Skylab Boot Assembly

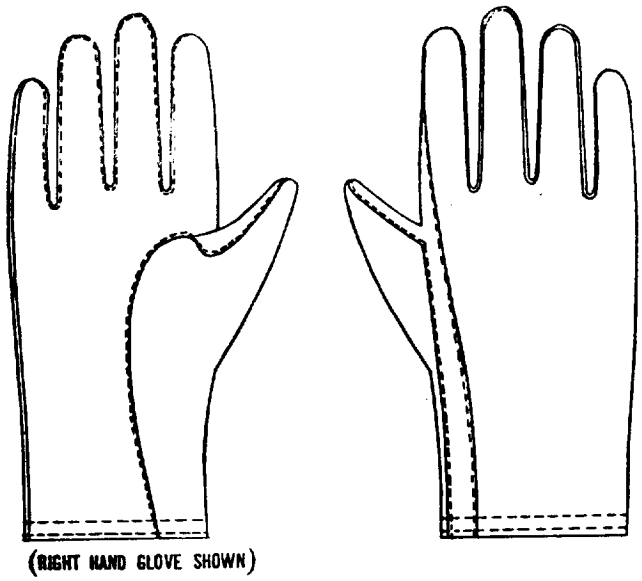


FIGURE 5: Skylab Glove Assembly

for the palm and front of the gauntlet, thumb and fingers, which were fabricated from seamless deerskin.

The glove, which came in six sizes, completely covered the hand and wrist for comfort and protection, while allowing only minimum degradation to tactility and mobility.

Two pairs of gloves were provided each SL crewman.

Underwear Sets

Skylab crewmen could select from four options for underwear sets. Each 28-day Clothing Module (described below) originally contained 14 of these sets, permitting a change of underwear every other day. Additional underwear was provided after SL2 (see "Skylab Findings" section for more detail) for the SL3 and SL4 crews. One set style or a combination of styles was allowed.

Set 1 (Figure 6) was a Full Union Suit having integrated socks but without an opening in the seat. An off-the-shelf item, the suit was 100% white cotton and came in standard sizes.

Set 2 (Figure 7) was a Half Union Suit. This suit completely separated at the waist, the lower half having integrated socks and no seat opening, and the upper half a standard pullover T-shirt. Both halves were off-the-shelf items, 100% white cotton, and came in standard sizes.

Set 3 (Figure 8) was a 3-item set: T-shirt, shorts, and socks. Three different styles of shorts were available: jockey, knee, and boxer. All shorts were white cotton and standard-size. The socks were white cotton and featured a reinforced heel and stretch top. The T-shirt was the same as in Set 2. The socks and T-shirt were also standard-size.

Set 4 (Figure 9) was an Apollo Constant Wear Garment (CWG), made of white cotton. The CWG was standard-size.

Garment Stowage: 28-Day Clothing Module/Contingency Clothing Module

Twenty-eight-day supplies of the above garments were originally packed as a modular unit for each Skylab crewman: one module per SL2 crewman, and two modules each per SL3 and SL4 crewman. The garments (excluding gloves and boots) for each of the crewmen were packed into a rucksack (as described below) to make the 28-day Clothing Module.

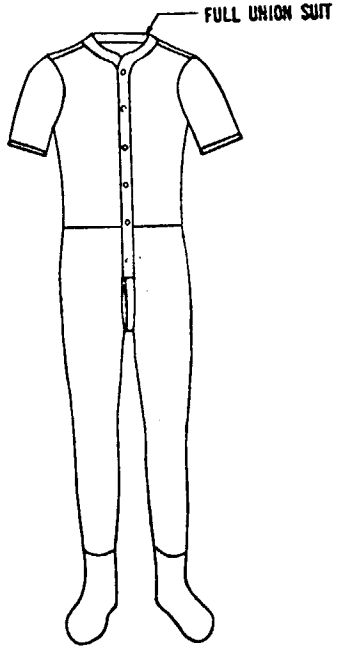


FIGURE 7: Skylab Underwear --Set 1

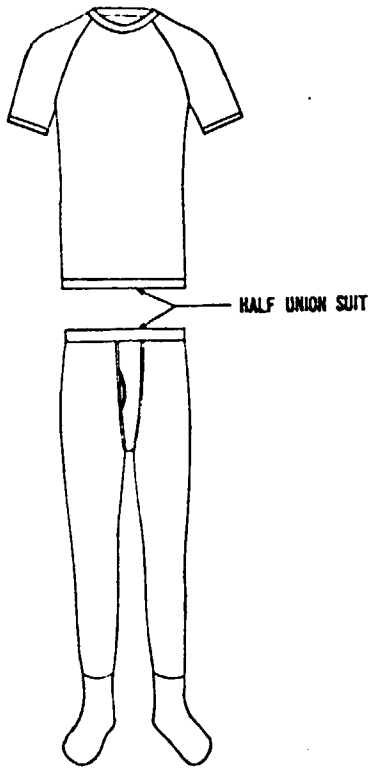


FIGURE 8: Skylab Underwear --Set 2

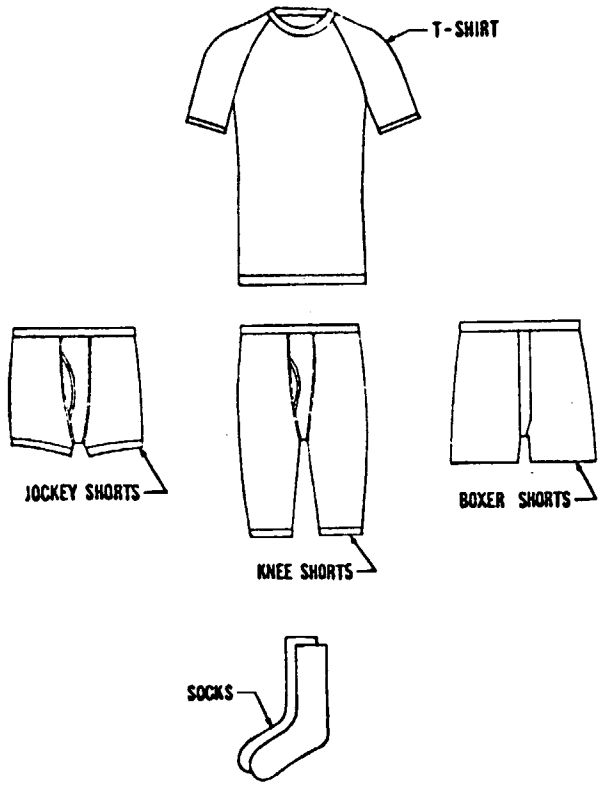


FIGURE 9: Skylab Underwear --Set 3

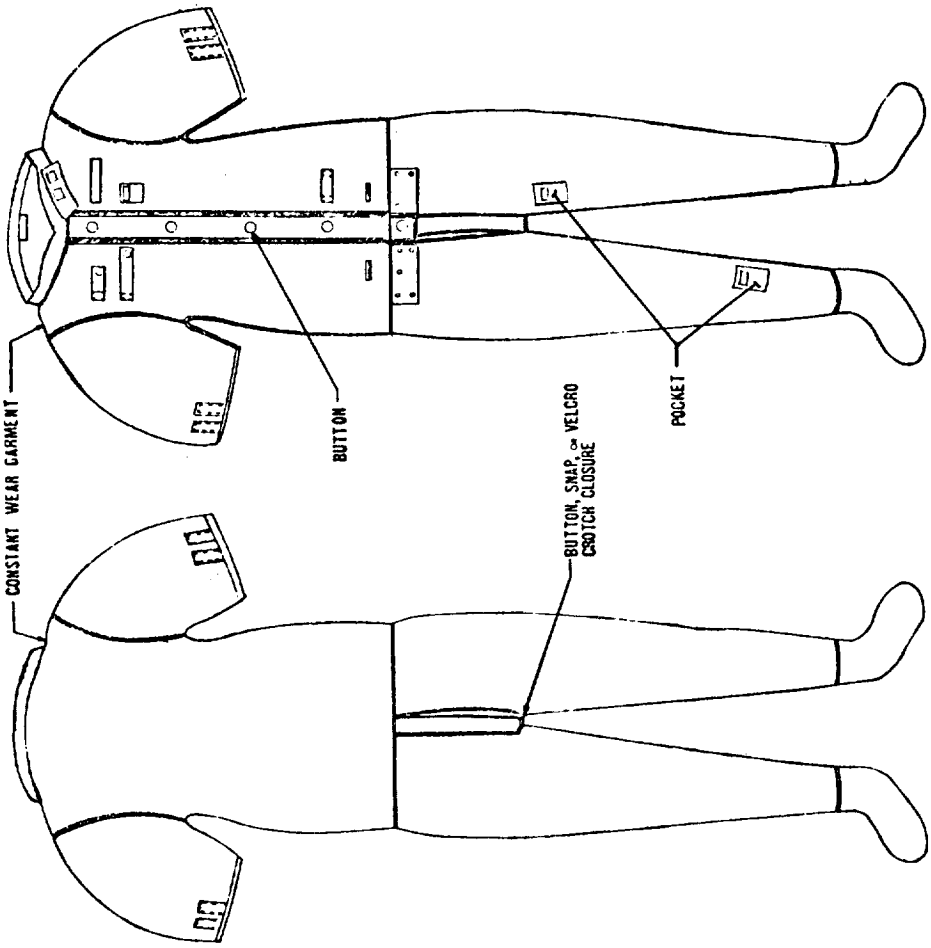


FIGURE 10: Skylab Underwear--Set 4

The Clothing Modules (sans Valet Kits), designed to fit the standard OWS stowage locker, were stowed in the Sleep Compartment (lockers S912, S924, and S934) for the on-board crew's use (Figure 10) and in the wardroom for the follow-on crews (Figure 11). Valet Kits--each containing one pair of boots and gloves--were stowed in one Contingency Clothing Module (see below) in OWS forward dome locker D416. Garment quantities selected by the Skylab crews for inclusion into their clothing inventories are shown in Table I. Contingency clothing (for backup crewmen) included 2 pairs of boots, 4 jackets, 6 trousers, 8 shirts, and 14 pairs of shorts.

The rucksack (Figure 12), fabricated from smooth-surface 14-mil Armalon, was sectioned into seven areas for specific garment containment. Each section was labeled to facilitate garment identification, and separation tabs and a hook/pile (velcro) closure system were incorporated in each section to allow single-item removal without affecting remaining items.

As a sub-assembly to the rucksack, the Valet Kit (Figure 12) provided sectioned-stowage for the boots and gloves. The Valet Kit could snap to the rucksack and could be removed as a unit and snapped to the OWS walls for temporary stowage.

A Contents Label (Figure 12) included in the Clothing Module identified the crewman name and garment contents (item and quantity) of the Module. The label also indicated the garment change cycle and enabled the crewman to keep track of garment quantity remaining.

Used clothing and empty modules were to be disposed of through the Trash Airlock (TAL).

Construction of the Contingency Clothing rucksack was identical to the unit discussed above, except the contingency rucksack had only three sections (Figure 13), and no Valet Kit attachment snaps were provided.

Within specified weight and volume requirements, a combination of garments was packed into two rucksacks: one contained the garments which fit backup crewmen for the last two Skylab missions. The other contained all gloves and boots in Valet Kits. The two contingency modules were stowed in the OWS forward dome area locker D416 (Figure 11).

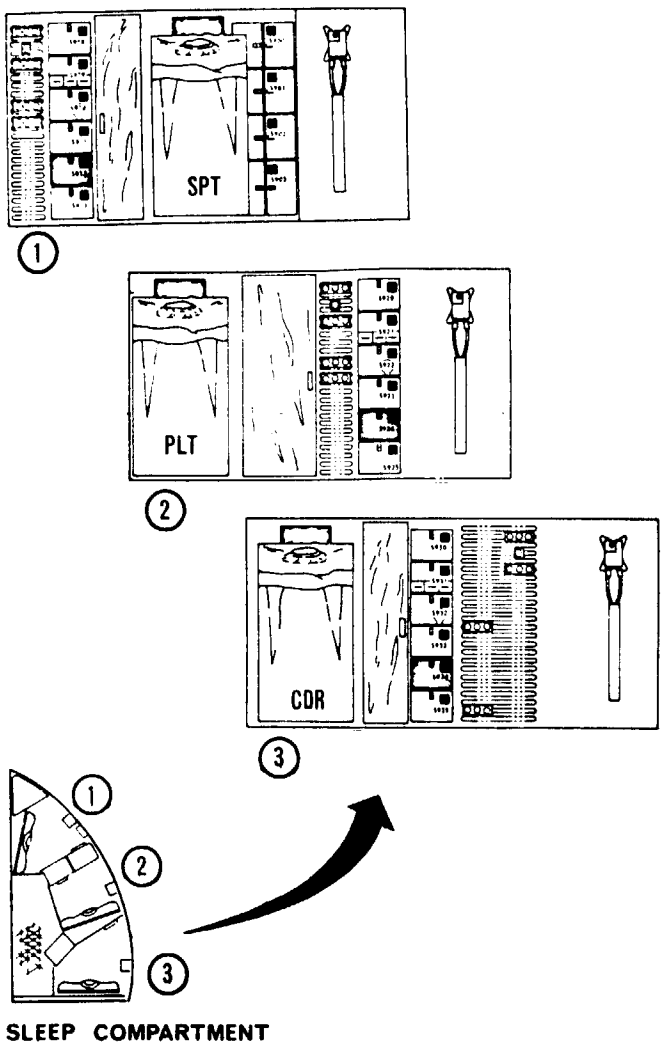


FIGURE 10: Clothing Module In-Use Locations

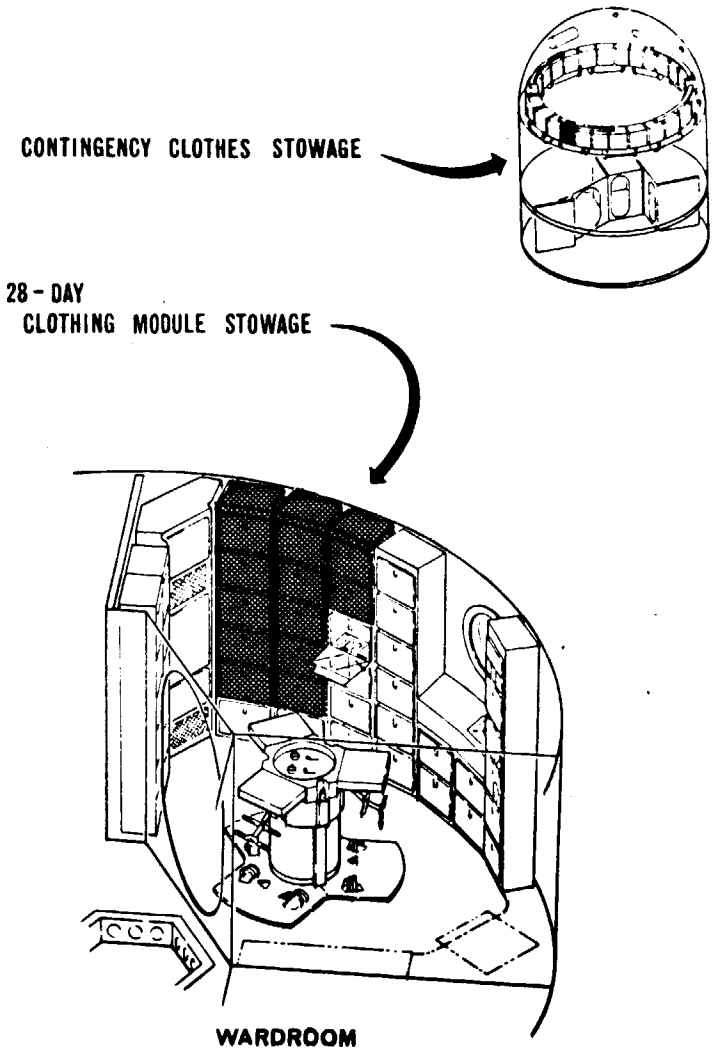
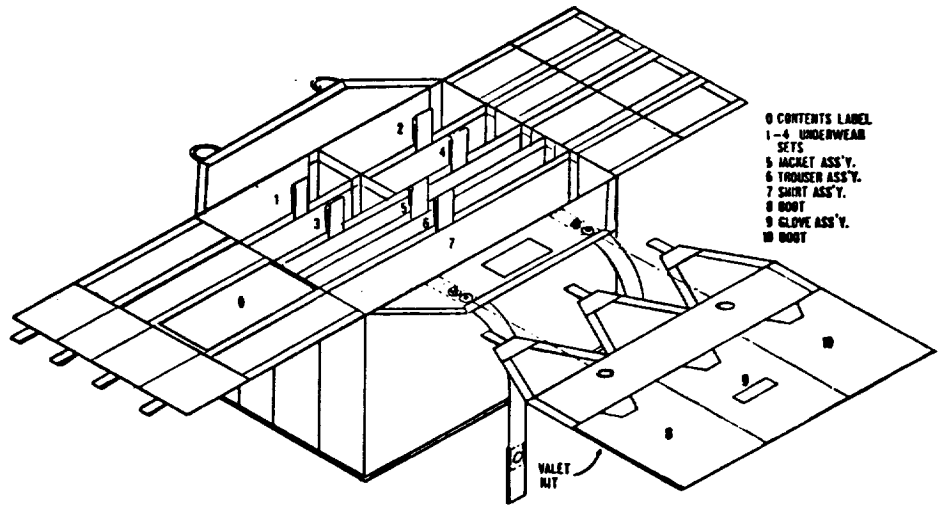


FIGURE 11: In-Flight Garment Stowage Locations

TABLE I: Skylab Crew Garment Selection

SL MISSION	CREWMAN	GARMENT: JACKET	TROUSERS	SHIRT	BOOTS	GLOVES	FULL UNION	HALF UNION	T-SHIRT	JOCKEY SHORTS	BOXER SHORTS	KNEE SHORTS	SOCKS	CWG
II	1	3	5	8	2	2	2	2	12	0	5	5	12	2
	2	3	5	8	2	2	0	0	13	2	1	10	13	3
	3	3	5	8	2	2	0	5	14	4	4	1	9	2
III	1	5	9	17	4	2	0	4	26	0	22	18	50	2
	2	5	9	17	4	2	0	2	26	0	26	8	24	4
	3	5	9	17	4	2	0	4	24	0	24	12	24	2
IV	1	5	9	17	4	2	0	14	32	28	0	0	54	3
	2	5	9	17	4	2	2	6	26	24	10	0	53	3
	3	5	9	17	4	2	0	8	28	27	20	0	47	3



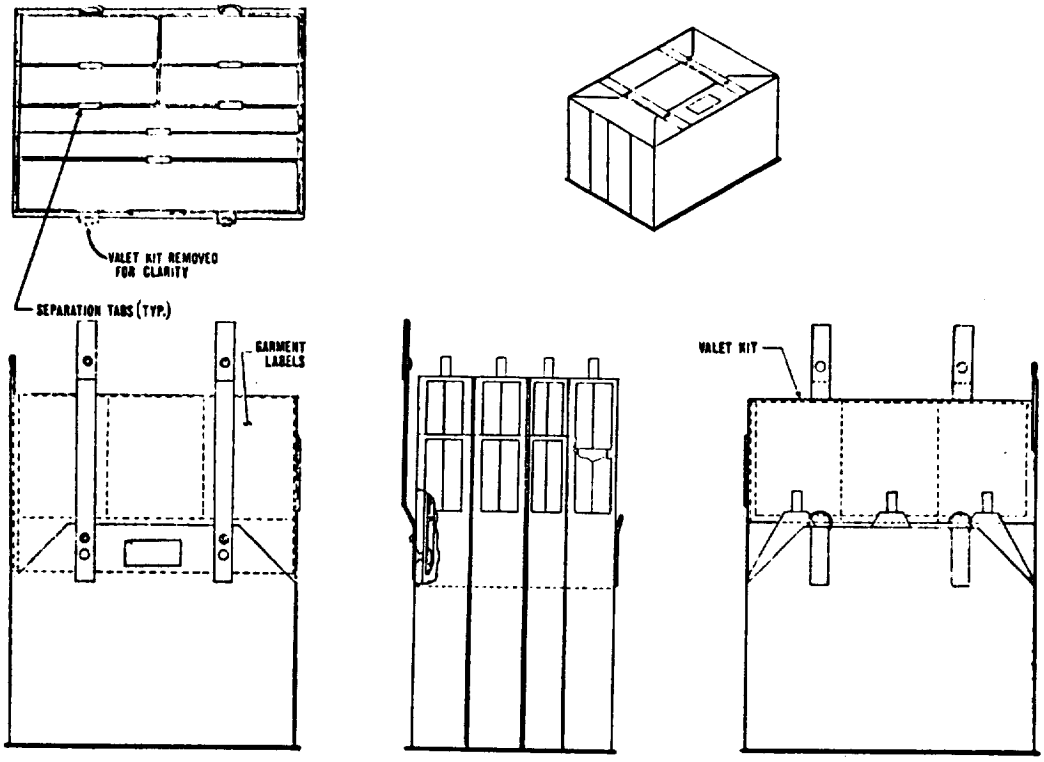


FIGURE 12: Skylab 28-Day Clothing Rucksack

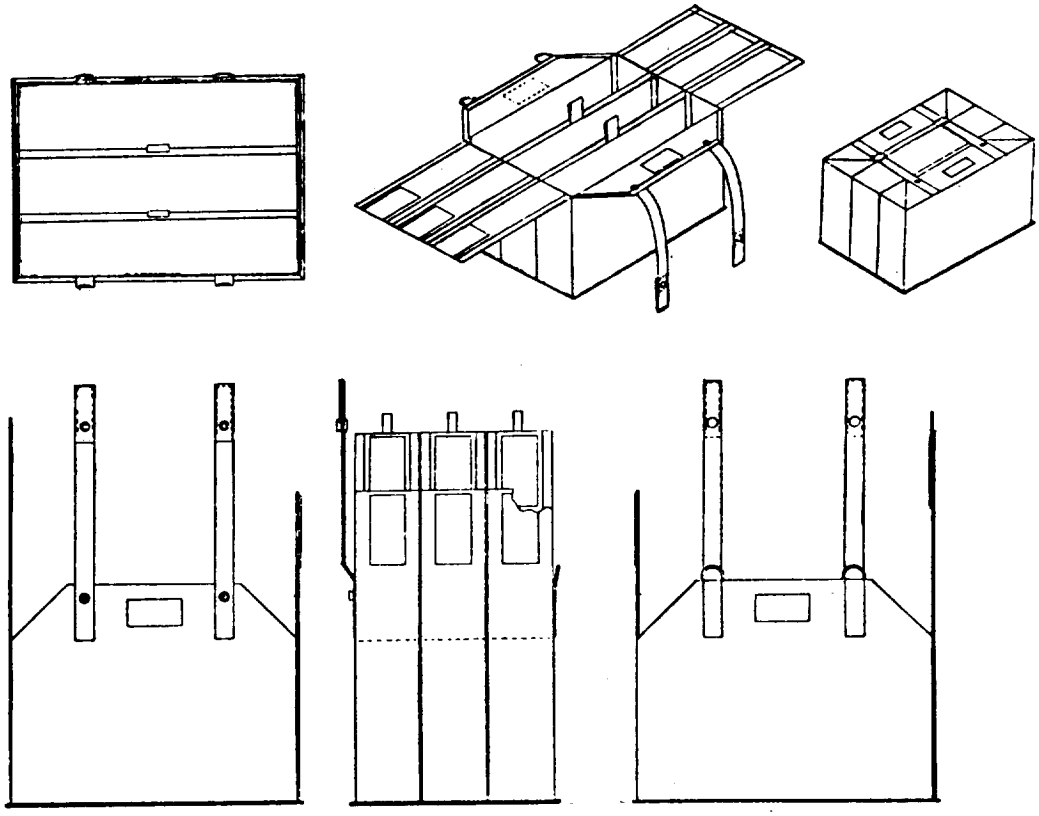


FIGURE 13: Skylab Contingency Clothing Rucksack

Triangle Shoes

The Skylab portable foot restraints, more commonly referred to as the triangle shoes, were not specified as garments, per se. However, since in some cases the crewmen tended to wear them as full-time footwear, the shoes (not to be confused with the soft boots described above) will be discussed as such in this bulletin.

The triangle shoes (Figure 14) were custom-fitted, high-top, lace-up shoes. The vamps were PBI. A removable triangular clete, which mated with the OWS grid, was fitted to the sole. A modification to the shoes in the form of protective toe caps was made for the SL3 and SL4 missions (see "Skylab Experience" below). Each crewman was provided one pair of shoes per mission.

FIGURE 14: Skylab Portable Foot Restraints (Triangle Shoes)

Bump Hat

The Skylab bump hat (Figure 15) was a hard-shell "hard hat" molded in a polyimide-fiberglass composite. The 2.5-pound helmet was to provide protection to the crewman during operations of the M509 and T020 experiment maneuvering units and during miscellaneous (e.g., maintenance) activities. The hat featured adjustable chin strap and headband assemblies made from PBI fabric, felt, and webbing, and a shock absorbing headliner made of Fluorel foam rubber. The one bump hat provided could accommodate the "Snoopy hat" communications assembly.

FIGURE 15: Skylab Bump Hat

SKYLAB EXPERIENCE

Thermal Qualities

The crewmen were provided a multi-garment system which incorporated trousers, shirt and jacket to be worn over the underwear. This inventory provided flexibility to the crewman for achieving thermal comfort by donning or doffing the jacket and by attaching or detaching the lower legs of the trousers with zippers. Gloves were also provided for thermal comfort and protection (as well as abrasion protection--this section addresses only the thermal aspects; the reader is referred to the "Head/Hand Protection" section for additional information).

The flexibility to use clothing as a means of keeping thermally comfortable was well accepted by all crewmen, as evidenced by the following crew comments:

- "The concept of...short sleeves and short-leg and... long-legged pants is superb. It works great. We used them a lot, and [that concept] should not be changed." (Ref. 2.14)

- "It was a little warm, but it cooled off after we got the lights off and so forth. And it warmed up in the afternoon, and we circulated around in here with everything from full trousers and shirts to skivvies--and seemed to feel quite comfortable temperature-wise in any of those clothes." (Ref. 2.16)

- "You use a lot of clothes in this business. You use clothes for when it's cold in the MDA, when it's hot here [in the sleep compartment]. You got your gym clothes for exercise, and you got your sleep clothes." (Ref. 2.21)

- "But I find...the garments are adequate in terms of... warmth...and that they are flexible enough so that they can be adapted to the environment that they're going to be in." (Ref. 3.24)

- "Well, temperature...was hot when we got here. It cooled off and was quite comfortable, and now we're back up into a hot cycle again. It's starting to get warm.... And the [spacecraft ECS] system can't keep

up with it and it's just getting warmer and warmer, but, thank heavens, we can doff clothing and stay reasonably comfortable." (Ref. 3.24)

Comments dealing with specific garments were also plentiful. Most of the remarks concerned the jacket, particularly its use in the MDA which apparently was the coldest "room in the house" (see also Ref. 1.29, 1.45, and 2.39):

- "You got to keep in mind we're [in] a little off-nominal situation, although we're basically nominal, that is, with MDA heaters on. There was a span... [in] which MDA was warm enough that the jacket was not required. However...before that, and as it is now we have the MDA heaters off in order to help keep the workshop temperatures down. Therefore, it is warm in the workshop and chilly in the MDA, and a jacket is an extremely useful item." (Ref. 1.27)

- "The jacket is used daily, every other day, depending on how long I'm spending in the MDA, the cold part of the vehicle. It's not on all the time, and I wouldn't be without it." (Ref. 1.28)

- "...the crew quarters tended to be a bit warm and the Multiple Docking Adapter was too cold. Crewmen generally wore jackets for Apollo Telescope Mount operations." (Ref. 1.49)

- CC: "And on the TV down here, we're seeing everybody wearing jackets. Are you cold up there?"
  SPT: "It's a lot cooler." (Ref. 2.18)

- "And in the event that I have a...tour of duty at the ATM or in the Command Module and I'm going to be there for a while, I zip the legs in, and I even bring a coat [jacket] if I feel it's necessary." (Ref. 3.24)

- "It gets a little cold up there [MDA]. I had to take a jacket up there to work on the ATM or anything else. I come down to the OWS, and I find myself taking the jacket off; sometimes the T-shirt." (Ref. 3.30)

Additionally the jacket was used for another purpose during SL2 parasol deployment activities when workshop temperatures were high:

- "I tried it for a while without my jacket. Actually,

your jacket served as a thermal barrier against the radiant heat from the walls. I took my jacket off, and after 15 minutes or so of that, I put it back on. It's more comfortable with the jacket on...." (Ref. 1.38)

The crews' acceptance of the trouser leg design can be summarized by the following comments:

- "A very pleasant feature that I found was the ability to zip on and zip off the legs of the trousers. I found that to be very pleasing and convenient, and whenever the weather was warm, I was quite comfortable in the short trousers." (Ref. 3.49)

- "The flexibility of being able to take off the legs and have shorts and have the long legs, I think was a very good design idea." (Ref. 3.17)

Only during SL2 was a desire for a lighter (than the jacket) shirt with long sleeves mentioned (Ref. 1.20). Only one of the nine crewmen voiced this personal preference: "I run cold all the time. When I was operating up in the MDA for four passes on the ATM, I'd get pretty cold...." (Ref. 1.55) He continues, "I would have liked to have had a long sleeved shirt like T-shirt or cotton only because that's the stuff that stays close to your skin, you know. You wear that jacket --but in zero-g everything tends to float out. My arms used to get a little cold sitting up there.... But that's an individual thing again."

However, most crewmen agreed on the use of the T-shirt/brown knit shirt combination. Although the pre-flight plan was for the crewman to wear the brown durette shirt over the cotton T-shirt, the crewmen commented:

- "It was a bit too warm to wear both the T-shirt and the soft shirt." (Ref. 1.46)

- "That's right, we operated with the T-shirt or the gold [brown knit] T-shirt, but never both." (Ref. 1.46)

- "I would feel more comfortable with just a T-shirt. Ideally, if you were running 68 or 70 degrees, you would probably wear them both. You would wear the T-shirt to absorb perspiration and the PBI shirt over that. But it was too hot a lot of times to do that." (Ref. 1.55)

- "During the day, I don't wear the turtleneck--what do you call it--the [durette] shirt either because...it's just too warm...and it's got that turtleneck to increase the warmth." (Ref. 2.30)

- "I just wear the jacket over my bare skin. And it's cool that way." (Ref. 2.40)

Underwear or socks worn at night complemented the sleep restraint blanket provisions:

- "...[the sleep compartment air vent] keeps my feet cold all the time. And that's one of the things that cause me to, on cool days, to sleep in a half union suit in order to keep my feet warm." (Ref. 3.17)

- "I usually wear one or maybe two pair of socks at night just so my feet don't freeze." (Ref. 3.29)

- "And so when the beta angle gets lower and we start getting cooler, I just put on a half union suit. That keeps my feet warm and the rest of my body stays quite warm. In the very hot weather, I sleep in the nude. ...[by] changing what I sleep in, the clothing I sleep in, ...I'm quite comfortable in the sleep restraint." (Ref. 3.15)

However, while satisfying body-weighing requirements in the morning, crewmen reported getting "chilly" while wearing only underwear (Ref. 2.68).

Gloves were used for thermal comfort (Refs. 1.55 and 1.10) and thermal protection (Refs. 1.1, 1.2, 1.24, 1.27, 1.38, 1.53 and 1.55). The gloves were used for protection primarily during initial SL2 workshop entry among hot hardware and for scientific airlock (SAL) experiment rod retraction. Gloves were used for thermal comfort primarily in the MDA, where temperatures were lower.

One of the major Skylab garment findings concerns the use of a two-piece set (shirt/trousers) rather than a one-piece coverall-type flight suit. From a thermal consideration alone, the crews' overwhelming acceptance and favoring of the two-piece set can be inferred from the comments above and summarized in this comment by the SL3 PLT:

> There was a lot of discussion preflight about one piece versus two, and I think two is good because it gives you the flexibility to stay at whatever temperature you want. (Ref. 2.66)

In summary, Skylab garments were generally satisfactory for crew thermal comfort.

Pockets

Skylab experience demonstrated the high degree of importance pockets have in the design of space clothing. Crew criticism --both positive and negative--emphasized the criticality of using the garments as "probably one of the best tools you have all day" (Ref. 2.66), particularly the pockets. Most of the crewmen agreed on the desirability of providing pockets to support many of their activities. However, in using the pockets, the crewmen reported several characteristics which warranted improvement, such as location, size, and retention mechanisms. The majority of pocket-related comments concerned general use of pockets for carrying items. One crewman remarked, "I've got places--pockets to carry all the stuff I want to carry around..." (Ref. 2.40).

The following references indicate the variety of items carried:

- "The penlight was a daily necessity that was used all the time throughout the vehicle. Scissors we used as a daily necessity at all meals, and we also used them to cut up teleprinter pads and other things." (Ref. 1.29)

- "I had alarm clocks [timers] going off in my pocket...." (Ref. 1.7)

- "Another thing you need to do [to prepare for working in Skylab] is to get a timer and a roll of gray tape and put them in your pocket." (Ref. 2.53)

- "I often took segments of meals up there [to the ATM C&D panel]. No, it was no problem at all. We had the large pockets in which I would usually take up three or four [food] cans of whatever was heated and two or three juices and go at them one by one. That was no problem at all." (Ref. 3.55)

- "I use my lower left pocket for trash, junk; every place I pick up some trash I put it in there and I hardly ever empty it. I just leave it full and throw it away when I throw away my trousers. My right lower pocket, why, I use that for picking up equipment that I might want to use. There's always restraints, and bungees, and stuff like that floating around and hooked to places where they are not being used, so

when I see one and I know I'm going to need it sometime, I pick it up and put it in that pocket and I use it sometime. In my left side pocket, I keep my tape and my timer in there. Always need that tape. The gray tape works everywhere, so I keep some handy. Always need the timer somewhere, too, so I can keep it handy there. My right side pocket, that's the flat one, I put my scissors in there.... The jacket's got pockets in it. Now you can keep pencils, flashlights, and tapes, and whatever junk you picked up along the way in the pockets...." (Ref. 2.30)

- "You need a place to keep a flashlight in the trousers but there isn't one there. It's not required, but it would have been nice if we'd have had one put there." (Ref. 2.17)

Numerous comments referenced below were made during all three Skylab missions concerning the use of garments to carry tools in even though a tool caddy was provided for this specific purpose:

Ref. 1.29
Ref. 1.47
Ref. 1.56
Ref. 1.57
Ref. 2.13
Ref. 2.16
Ref. 2.19
Ref. 2.41
Ref. 2.51
Ref. 3.8
Ref. 3.16
Ref. 3.37
Ref. 3.42

In summary, most of the crewmen found carrying the required tools was more convenient in pockets or elsewhere in their garments (e.g., stuffed into trousers waistband).

Snagging the pockets (or the items within pockets) was a minor, although nagging, problem:

- "One thing I mentioned last time about them [the garments] snagging, and that is the book pocket. There's one on my left hip. The pocket's not long enough for the book, and the book's inclined to snag on things." (Ref. 3.24, see Figure 16)

FIGURE 16: Book In Pocket--Potential Snag Problem

- "The pocket that holds the little Flight Plan book and also the scissors pocket [tend] to snag.... I finally took the cord [lanyard] off my scissors because I figured it was a safety hazard." (Ref. 3.22)

- "I went into the airlock one day, and I had the zipper in my pocket on the bottom left leg open. And it caught on something and just ripped the pocket halfway down. I was really whistling along, though." (Ref. 3.23)

The box-style pocket was preferred to the flush-style pocket since more volume was available for stowing items (Refs. 2.32 and 2.72). The flat flush pocket was used for carrying smaller items out of the way (e.g., scissors--see Ref. 2.30).

One of the crewmen suggested a "kangaroo-pouch" type pocket would be convenient on the front of the shirt. Because of the zero-g environment, the shirt (i.e., the brown knit) had migrated upwards, which placed the available zipper pocket over the shoulder, rendering the pocket useless (Refs. 3.49 and 3.51).

Two major pocket characteristics--size and retention mechanisms --received a panoply of comments.

- "All those neat little extra pockets what we had put on so that we could carry our little folder books around and our pens and scissors and all that stuff were not properly sized, and we were unable to use them in the manner for which they were designed.... We paid the price with inconvenience. The flashlight would not fit in the flashlight pocket, the scissors would not fit in the scissors pocket, and the book would not fit in the book pocket.... So you found yourself putting things wherever you could. I'm the kind of person who likes to put things in their place and have them there so that when I need them quickly I can just grab at them. If I can't always put my pencils in the same pocket or put my flashlight in the same pocket, some time when I need them, it will cost me extra time and thought process to locate my pen, pencil, or flashlight. And that's the kind of time you don't need to waste. You don't need to waste time looking for something in your pockets. You ought to know where each item is, and you ought to be able to get to it quickly so that you can do the important things without delay." (Ref. 3.49)

- "...the scissors won't stay in [the pocket designed for them] because the flap won't lock over the top of it. The pocket that's designed for the flashlight is too short. The flashlight comes out. It's too bad because those would have been very, very handy pockets. It's just that the doggone retention straps don't hold the item in. The pockets that hold in our little trifold [Teleprinter Message] books just barely hack it. And I don't see any reason why they couldn't have added an extra half inch onto the strap or another inch of depth onto the pocket. As it stands now, the pocket is not deep enough. There's about 3 inches of the book that sticks out, and the book is inclined to hang up on things as we sail by them [see Figure 16]. I think probably we should have made the pocket another 2 inches deeper and just had an inch of the book sticking out. We would have been a lot better off." (Ref. 3.17)

- "Pencil pocket works good and the little pocket for your PRD works good, your dosimeter. And it's that other pocket back there for your scissors--[it] doesn't

work good at all. It's not big enough to keep the scissors in. The scissors are too long for it. It keeps coming loose and the scissors come out. Too much of a nuisance to hang them on a lanyard because you have to unwrap them every time you want to use them, so I wind up putting them in one of the other pockets. That scissors pocket is no good for nothing [sic]." (Ref. 2.30)

The SL4 CDR neatly summarizes the general concensus on the pocket/item fit interface:

> The most important recommendation I would have for the IVA garments is, for crying out loud, let's be more careful about how we design all these little special-purpose pockets and make sure they fit, with a little bit of leeway, the things that you intend to put in them. (Ref. 3.24)

Zippers and flap/velcro patches were used as two pocket closure mechanisms. The flap/velcro patches were reportedly inadequate: the flap being too short and the patch too small.

- "We all wanted our scissors. Those scissors pockets were terrible. The flap didn't overlap enough and they just had a little piece of velcro on it. Same thing with the knife pocket...." (Ref. 2.66)

- "I think the only bad thing about the clothes are the pockets for the scissors, the pocket for the knife. We should have made a flap that held them down with velcro about twice as big, so as to get some velcro grip. We're always losing scissors and knives because they get banged out of our pockets as we go through hatches." (Ref. 2.14)

- "The Swiss Army Knife was very handy. It would float out of the knife pocket [with flap/velcro closure], unless it was restrained. I never restrained mine; I carried it in a zipper pocket." (Ref. 1.46)

Zipper closures were generally satisfactory. However, a zipper pull tab was desired:

- "Well, any place there's a zipper, there ought to be a zipper-pull tab on the zipper, if it's nothing more than a little inch and a half lace or cord with a knot in it or something like that. But I find myself

irritated by having to hunt and probe for the little zipper-pull in order to get at a flashlight in a hurry. Also any place there's a zipper, there ought to be an opposition pull-tab. In all, I don't think that's so critical on the clothing here. But they just left these off every place." (Ref. 3.22)

- "I think Bill [the PLT] indicated on one occasion that the zippers should have had pull tabs on them. Ed [the SPT] and I agreed with him 100 per cent. Those zippers were sometimes hard to locate in your pockets. If there was a little pull tab, it would have been much easier to grasp." (Ref. 3.49)

The importance of providing positive retention for stowed items was equalled by the need for positive retention of other articles during the retrieval of any given item stowed in the same pocket. In general, retention of items, especially smaller ones, was a continuous problem:

- "You end up putting them in your pocket, and you can't see in there, and you open the lid, and five screws fall out, and you have to go get them." (Ref. 2.42)

Additionally, pockets on the lower trouser legs were not so easily accessible as those on the upper legs since, in zero-g, a hand-to-lower-leg/foot position was more difficult to maintain (see "Don/Doff Activities" section). Also, bulk on the lower extremities somewhat impaired crewman mobility (see "Shoe/Boot Wear" section).

Overall, the pockets proved a valuable tool in supporting the crewmen in their daily activities. Pocket design philosophy was summed up nicely the the SL3 CDR:

- "They [the clothes designers] should consider what [the crewmen are] going to use each pocket for. That becomes critical as far as where the tape and your timer were. All those things should be developed first, then the clothes can be designed. If we had done a better job on the clothes, we could have worked faster on a day-by-day basis." (Ref. 2.66)

Fit

Prior to Skylab, man had not been physically measured during flight to assess the effects of zero-g on his anatomy. Girth

and height measurements were made during the Skylab 4 mission: quantitative results indicated a sufficient body change occured to warrant additional study for possible application to the design of future space clothing. On the average, height increases of 2 inches were recorded.

Several comments during Skylab indicate that the effects of zero-g are noticeable, in terms of garment fit:

- "In zero-g, a guy becomes more slender and grows taller, and those things ought to be taken into account in clothing design." (Ref. 3.49)

The jacket and trousers were custom-fit garments; however, the SL4 PLT reported:

- "All my sleeves were too long. The over cover [outer sleeve] there was just a little bit too long and I ended up cutting those with scissors." (Ref. 3.49)

The SL4 CDR suggests that the height expansion "may be why I was getting the ride-up effect [of the trousers] on the legs. I would move my legs and my trousers would ride up on me and when I would straighten my leg the trouser was still high. So I noticed that frequently I would kick my leg in order to throw my trousers down a little further..." (Ref. 3.56). However, other crewmen reported no garment migration.

One crewman who selected the boxer-shorts option remarked, "...I was kind of test hopping those boxer shorts...I wore them but I didn't like them because they bulge out all the time..." (Ref. 1.55). This ballooning effect led the crewmen to prefer the other underwear options (i.e., jockey/knee shorts, union suits).

Weightlessness caused a shift of viscera which effected a decrease in the waist circumference:

- "You don't need as big a waist [on the trousers] as we had because there is no gravity to pull your gut down, and your waist tends to shrink in." (Ref. 1.46)

- "My trousers all fit too big because I lost some weight before flight. It'd be nice to have a little more adjustment capability on [the] waistband [which] would be nice because you also have a visceral shift in zero gravity." (Ref. 3.49)

Shirts were provided in standard sizes. The SL3 PLT, who wore neither the knit shirt nor the T-shirt, remarked, "I didn't like the tight fit [of the knit shirt]. They fit too close all over. It doesn't feel nice and loose like a T-shirt, or like the [casual] shirt you got on now [during the debriefing]..." (Ref. 2.66). The SL3 CDR wore the PLT's T-shirts because "they were a little bit larger..." and "felt better" (Refs. 2.58 and 2.65). The SL4 PLT also wore the leftover SL3-PLT's T-shirts:

- "They weren't too baggy because clothing rides up in zero gravity anyway..." (Ref. 3.56).

Overall, Skylab garment fit was satisfactory.

Jacket/Trousers Cuff Inserts

The knitted cuff inserts in the jacket sleeves and trouser legs were originally included to provide thermal insulation and prevent sleeve/leg migration. The cuffs were designed to be removable in-flight at the crewman's option, without damage to the jacket or trousers.

Mixed feelings resulted over the cuffs:

- "[Cutting out the cuffs] was an improvement. The cuffs were there in case it got chilly and to keep the trousers from floating up in zero-g. However, the trousers stayed fully extended down the legs. Al [the CDR] routinely cut the cuffs off." (Ref. 2.66)

- "One thing that would have made the trousers and the jackets nicer would have been if I could have gotten the legs on and off over the traingle shoes. It could be done but it was a problem. I like the idea of having that sweat shirt fitting underneath, but it would be nicer to have a little more stretch." (Ref. 3.49)

- "I wound up doing what Al [the CDR] did with his clothes and that is taking the elastic inserts out of the sleeves and out of the legs to make it cooler. They were not required to keep your trousers from riding up or your sleeves from riding up. The clothes assumed their normal shape in zero-g just as they did in one-g." (Ref. 2.58)

- "I don't know if I agree that elastic cuffs are not necessary. They sure keep your trousers from riding up on your leg. The problem is elastic cuffs can make it difficult to put a foot through a pants leg with a shoe on." (Ref. 3.56)

- "[The cuffs] kept the sleeves from riding up too much on me...so I liked them. But these guys found them to be somewhat of a hindrance." (Ref. 3.59)

- "I was a little different. I took the knitted portion out of the trousers and left the knitted portion in all of the jackets..." (Ref. 2.58).

- "I was more put out with them on the trousers than I was on the sleeves or the jackets, because I couldn't take my trousers off without taking my shoes off, you know, undressing for PT [Physical Training]. And then the sweat shirt knitted-cuff-type underneath, bothered me a little bit because of the watch." (Ref. 3.61)

- "I find it difficult to get the jacket on and off with a wrist watch on, particularly if you have to use the passive radiation dosimeter on your watchband. I finally took the PRD--the passive radiation dosimeter--off the watchband because it was so cumbersome." (Ref. 3.22)

- "I like the elastic [cuffs] on the arms because I like to pull up the arms and that way they'd stay up." (Ref. 3.56)

The question of whether leg/sleeve migration occurred varied widely from crewman to crewman. By being provided the option of cuff removal, all crewmen were apparently satisfied on the subject. In summary, the most disconcerting problem with retaining the cuffs in the garments was donning/doffing the clothes over the watch/PRD and shoes. A looser-knit cuff was suggested.

Don/Doff Activities

In general, donning and doffing garments was of no major concern to the crewmen. Most of their comments referred to the shoes--either in regard to the time-consuming lacing task, the shoe bulkiness during trouser donning, or the body attitude required to don shoes.

- "One of the problems that we have with [the triangle shoes] is getting them off. It takes an awful long time to get them off and get them on; it's awkward. I don't think the lacings that we have on these shoes is the answer. It's awfully time consuming taking them off and putting them back on, and we have to do this several times a day because of medical experiments or one thing or the other. Working out, when you clean up, at random--probably putting our shoes on and taking them off--four to five times a day. And the lacing gets to be an irritation. And it's time consuming." (Ref. 3.7)

- "[With low top shoes] there would be less effort lacing them up every time. ...we don't need laces." (Ref. 3.54)

- "...laces [on the shoes] could have been done away with, too." (Ref. 3.54)

- "[Although there were no triangle shoe foot restraints in the waste management compartment,] you weren't going to bother taking off your shoes [when entering the compartment]. It was easier to float around and be uncomfortable than to bother taking your shoes off." (Ref. 2.66)

- "...[the PLT] and I both use the triangles [shoes] all the time because it was just easier than changing about." (Ref. 1.53)

- "...it's a pain in the neck, to me, taking these triangle shoes off and on with all the laces. I'd like zippers [or] something else on them." (Ref. 1.20)

- "Lacing and unlacing those shoes bugged me." (Ref. 1.52)

The laces had been provided, in part, to give ankle support; however, some crewmen felt less support was desirable to keep the calves conditioned (Ref. 3.3) and did not lace the top eyelets (Figures 17 and 18); others like the support (Refs. 1.52 and 3.45). Some crewmen wore the triangle shoes all day in order to avoid changing to another pair. Others changed to complement the task being performed (Refs. 1.52 and 2.66). Other closure methods (e.g., zippers, fewer laces, hook/eye) were suggested (Ref. 1.52).

The problem of donning the trousers over the shoes (as well as the jacket over the PRD/watch) is discussed in the "Jacket/

Trousers Cuff Inserts" section above. The major contributor to this problem was the jacket/trouser cuff insert (Ref. 3.22).

Most crewmen commented on the difficulty of holding a posture to tie/untie the shoe laces and don/doff the shoes and socks. To bend over required using the stomach muscles; the absence of gravity to assist in bending was noticeable (Refs. 3.3, 3.13, 3.31 and 3.33).

Donning/doffing of garments occurred primarily in the sleep compartment (Refs. 3.50 and 3.58). The crewmen generally floated to don/doff their clothes; the sleep area was small enough and the drift rates sufficiently low that rebounding off the walls was no problem (Refs. 2.66 and 3.36).

Donning both trouser legs simultaneously decreased dressing time (Refs. 1.6 and 2.38); however, in several cases, adequate crew time had not been allowed in the timeline for dressing (Refs. 3.27 and 3.28), particularly during post-sleep activities (Ref. 3.47).

Only two crewmen reported static electricity occurrence during shirt doffing--a "hair-raising" experience primarily on the arms and head (Refs. 2.67 and 3.59).

Clothing Packaging/Stowage

Although the clothing module was compartmentized, the individual garments were vacuum packed and compressed during packaging to fit in the rucksack. When the packaging material was removed, the garments expanded, completely stuffing the module. The SL2 crew made these observations (Ref. 1.55):

- "What do you guys pack those clothing modules with, the same ram you pack the main chutes with?"
- "[If you pulled too many of an item out,] you'd never get it back in again. You gotta get to about [mission] day 14 before you can handle anything in there."
- "...I tried to pull one set of skivvies out and got the whole section out. I wound up with clothes in two lockers for about 14 days."
- "...if you pull a pair of socks out, they grow to about size 98 as you're pulling them out and holding everything else in."

Restowing leftover clothes was no problem, nor was disposal of used garments through the Trash Airlock (TAL). However, to repack the garments in clothing modules for re-entry would have been too time consuming, if not impossible.

Provisions for overnight stowage of clothes were marginal (Ref. 2.23). Utility restraints--rubber cups, each having a cruciform slit into which items could be inserted for temporary restraint--were provided in each sleep area for this purpose (Figure 16). These restraints were welcomed (Refs. 1.19 and 1.44) but did not completely solve the problem of overnight stowage (Ref. 2.23). Garments were hung on experiment equipment (Ref. 2.59), rolled and wedged into the grid or between the SIA (Speaker Intercomm Assembly--comm box) and light (Ref. 2.23), and stuffed under comm box cables (Ref. 2.66). An area more akin to a closet where clothes could be "hung" and allowed to "air" out of the crewman's way was suggested.

On several occasions, the crewmen were unable to locate specific garments for use. This was particularly true of the bump hat and gloves, which had been relocated from the 28-day clothing modules to a dome locker prior to SL1 launch (Refs. 1.28, 2.1, 2.2, 2.3, 2.4 and 3.56). After the SL3 CDR had restowed and completed an inventory of leftover garments at the end of his mission, he suggested new decals be applied to those lockers containing these garments for the benefit of the SL4 crew (Ref. 2.57).

Non-Wear Garment Uses

Skylab clothing served two major purposes: attire for the crews and rags for housekeeping activities. The latter was the primary non-wear use first reported during the SL3 mission (see also Ref. 2.47):

> One of the things we're doing is we got a bag over on the wall by the M131 equipment which is our rag bag. And every time we have old shirts and shorts and the like, which is almost every day, since everything's thrown away, we put them in that bag. Sometimes it gets too full and we shoot it out the trash airlock. But there's always some rags in there; so when it comes time to water clean, or wipe or something like that, we usually go over there and find a clean T-shirt or a clean pair of shorts or something like that--and most of the time they're fairly clean because we change them so frequently--and use [the clothes] instead of trying to do all that cleaning with these tissues. And maybe they ought to put that as one of the regular plans because it sure makes cleaning a lot faster. I think it gets things a lot cleaner. You sure get them a lot dryer. And it's just esthetically more pleasing to be cleaning up with a rag than it is with one of those little 2-by-6 tissues. [Ref. 2.27]

FIGURE 17: Sleep Compartment Utility Restraints

The rags were used for most major housekeeping (cleanup) tasks and were preferred to the tissues/wipes for smaller spills or wipe-up chores (Refs. 2.47 and 3.18). Only the cotton material garments were used for rags as the brown garment material was not very absorbent (Ref. 3.56). Garments (especially the extra underwear launched on SL3 and SL4) were also used as launch packaging (Ref. 2.8) and sleep compartment light baffles (Ref. 3.56).

Use Rates

Pre-launch garment use rates were planned to allow for each crewman one jacket per week, one pair of trousers per week, a shirt every four days, and a clean set of underwear (including socks, shorts, and T-shirt) every 2 days. One pair each of boots and gloves was provided for a two-week period. One pair of triangle shoes was provided per man per mission.

Numerous crew comments were made regarding the planned use rates. All crewmen agreed no additional jackets and trousers were needed, and fewer of each probably would have sufficed (Refs. 1.46, 2.5, 2.28, 2.30, 2.36 and 2.52). Recommended frequencies for one jacket ranged from two to four weeks, and for one pair of trousers from one to two weeks (Refs. 2.37, 2.66, and 2.72).

The planned mode of wearing the brown knit shirt over the T-shirt to satisfy flammability requirements was not practiced as the crewmen felt this mode was too warm. Therefore, wearing only one shirt at a time increased the total number of shirts available for wear. Regardless of the total number of shirts/T-shirts, the concensus was that a daily change was desirable, particularly for the brown shirt; however, one shirt for two or three days was acceptable when the T-shirt was worn (Refs. 1.47, 2.37, 2.40, 3.38, and 3.56). Exceptions to this were the SL3 PLT, who wore the T-shirt only for sleeping and did not wear the brown shirt (Refs. 2.30 and 2.40). He normally wore only the jacket for daily activities (Figure 18). Additionally, a few crewmen chose not to wear the brown shirt because of the shirt characteristics (see "Material Selection" section).

Daily changes of shorts and socks were desired throughout all three Skylab missions (Refs. 1.46, 1.50, 1.55, 2.30, 2.44, 2.46, 2.66, 2.72, 3.32, 3.35, and 3.38). Following the recommendations of the SL2 crew, additional sets of shorts and socks were launched with the SL3 and SL4 crews as follows:

FIGURE 18: SL3 PLT's Nominal Dress Mode

ITEM	SL3	SL4
Shorts	66 total	63 total
Socks (pairs)	28 total	107 total

The quantity of gloves provided was apparently adequate since reported wear of the gloves was limited (see "Thermal Qualities" and "Head/Hand Protection" sections); in fact, one crew found the valet kits containing the gloves only shortly prior to the mission end (Ref. 3.56).

Footwear, including the soft boots and triangle shoes, was used daily, on a few occasions, various crewmen did work in stocking feet, usually during activities adjacent to the sleep period. Some crewmen changed from soft boots to triangle shoes as the activity being performed dictated (Ref. 1.22); others wore only the triangle shoes (Ref. 2.15), and some the soft boots (Ref. 1.8). As the footwear wore out and became torn or abraided, the crewmen recommended providing additional shoes. Rather than launch additional triangle shoes for SL3 and SL4, shoe tops and protective toe caps were provided to prolong shoe life. Modified boots were also provided, identical to those on board but made of Kevlar (a high tensile-strength material) instead of the woven durette. The reader is referred to the "Shoe/Boots Wear" section for additional information concerning the footwear.

Use rates were calculated for each of the Skylab missions for the major garment items: jacket, trousers, shirts (including T-shirts), shorts (including all style options), and socks. These data are shown in Table II. Rates for SL4 were derived from the daily crew reports of garments worn and discarded beginning on Mission Day 7 and continuing throughout the mission (Table III).

With reference to Table III, several comments are noteworthy:

- Both the CDR and SPT wore more shorts than were provided them--these were leftover clothing from previous crewmen--and used almost all of their socks, while the PLT wore approximately half of those provided him.

TABLE II: Skylab Garment Use Rates

NOTE: Use rate units = no. items/day per crewman

GARMENT	SL2*	SL3**	SL4***	SKYLAB AVERAGE
Jacket	1/9.7†	1/11.8	1/27.3††	1/16.3
Trousers	1/5.8	1/15.9	1/14.1	1/11.9
Shirt/T-shirt	1/1.38	1/2.22	1/2.31	1/1.97
Shorts	1/2.45	1/2.32	1/2.35	1/2.37
Socks	1/2.62	1/2.20	1/2.17	1/2.33

*Rates based on total no. provided ÷ no. of mission days since no quantitative use data is available from this mission.

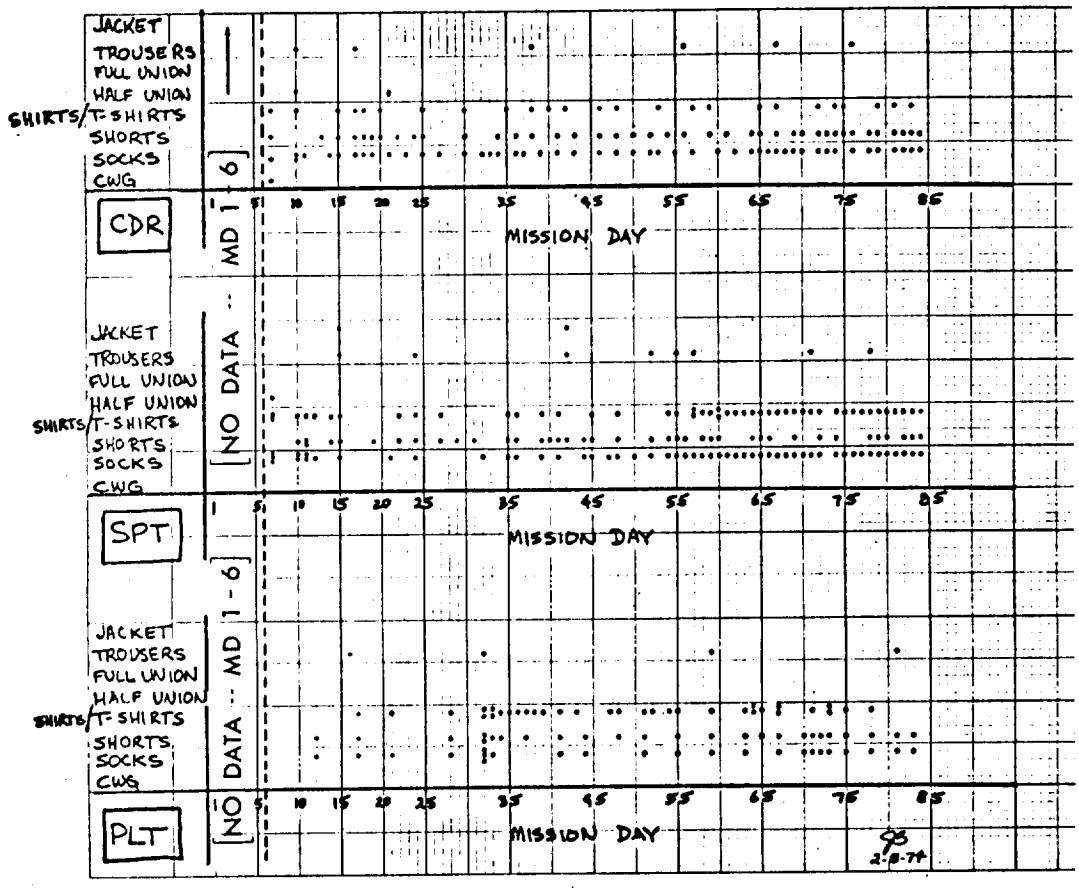
**Rates based on total no. provided less no. of items leftover per inventory reported on Dump Tape 267-03, pp. 8-10 ÷ no. of mission days.

***Rates based on evening crew reports of garments discarded daily.

†Specific use rate is the average for all three crewmen for that mission.

††Data for CDR and SPT only; no jackets reported discarded by PLT.

TABLE III: SL4 Reported Garment Use



- The SPT wore more shirts/T-shirts than had been provided while both the CDR and PLT wore approximately half of their provisions.
- Between Mission Days 34 to 45, the PLT reported a back rash on which he used a skin cream; the increased frequency of shirt change is noticeable during this period.
- There is an apparent tendency toward more frequent use of specific garments (i.e., shirts, shorts, and socks) during the mission end, particularly for the SPT.
- The individual differences in garment use is evident.

The inventory card (Figure 19) provided in each clothing module to assist the crewman in monitoring the quantity of garments available was found to be a "great help" (Ref. 1.55) by the SL2 CDR; however, other crewmen did not use them (Ref. 2.58).

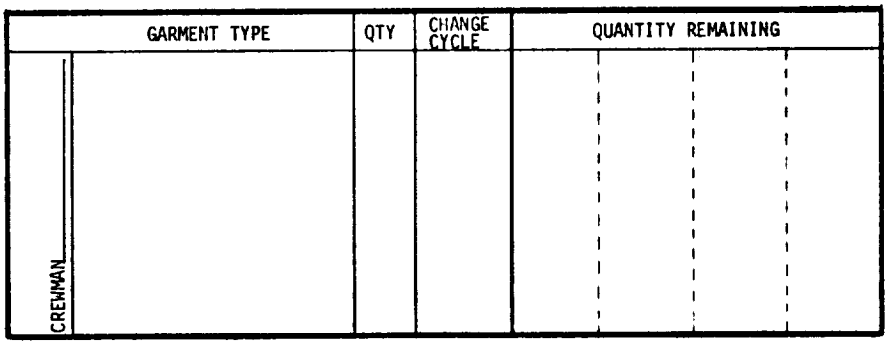


FIGURE 19: Clothing Module Inventory Card

Garments worn for normal activities ranged from full complement of long trousers/shirt/jacket with shoes to underwear only with socks (Ref. 2.25). Lack of foot restraints for the sock-mode (Refs. 2.15, 3.20 and 3.48) and poorly-sized restraints to accommodate the footwear (Refs. 2.29 and 2.48) were reported.

Cleanliness

Soiling of the garments resulted primarily from the wearer's body rather than from external sources. The vehicle was clean (Ref. 1.46), the humidity low (Ref. 2.12), and "you just don't get as dirty up here..." (Ref. 2.36). Food was the main contributor to external dirt.

There was essentially no perspiration during non-exercise periods (Ref. 3.53); however, the crewmen reported a need for absorbent clothes to accommodate perspiration during exercise periods (Ref. 3.65). The clothes wet in this manner dried rapidly in the low humidity (Ref. 2.70) and, except for the brown knit shirt, did not retain a body odor (Refs. 1.55 and 2.32). Additionally, feet perspired particularly during exercise, making the socks wet and clammy-feeling on the second day of wear (Ref. 1.46).

Material Selection

Materials for Skylab garments were selected primarily on the basis of flammability characteristics, rather than on crew comfort. While the cotton garments were generally well-accepted, the durette (particularly the brown knit shirt which was form-fitting and worn next to the skin) was highly criticized. The shirt material, which met flammability specifications for an outer garment, was referred to by the crewmen as non-absorbent of perspiration, clammy, smelly, too warm, not good for repeated wear, uncomfortable and itchy (Refs. 1.46, 1.55, 2.30, 3.14, and 3.42). Some crewmen never wore the brown shirts (Refs. 2.58 and 2.72). Crewmen from all three missions reported this material (i.e., the knitted durette) to retain an offensive odor when the perspiration dried.

The cotton garments did not meet flammability specifications for outer garments, although they were often worn as such. This issue was briefly discussed during a post-SL2 debriefing (Ref. 1.55): "...for the period of time that's involved there [for wearing the garments, we feel] that's acceptable...." The SL4 SPT added, "None of us [the SL4 crew] could wear it. You can't put up with that brown shirt against your skin." (Ref. 2.66). He concluded, "I would like to see some fire restrictions such that we could get some good-looking clothing in here..." (Ref. 3.8).

The garment materials were judged resistant to tearing and abrasion (Refs. 3.23 and 3.24) except for the footwear, which received the most wear (see "Shoe/Boot Wear" section).

Worn garments were utilized as rags for housekeeping tasks; however, only the cotton items were used in this manner as the brown material lacked sufficient absorbency (Ref. 3.56).

Providing an absorbent material to be worn for exercise periods, such as disposable paper knit, was recommended (Ref. 3.65).

Shoe/Boot Wear

Of all IVA garments on board, the footwear showed the greatest wear. The crewmen used their feet for maneuvering and stability; toes were poked into the grid and hooked under hardware, and feet were dragged to brake motion or change direction. Therefore, most of the wear was on the toes of the footwear (Refs. 1.9, 1.20, 1.46, 1.54, and 3.5). Protective toe caps were provided to the SL3 and SL4 crews and mounted to the triangle shoes (Figure 20); the toe caps did not prevent fraying but prevented further structural damage (Ref. 2.58). The drawback to the toe caps was the installation procedure which took an inordinate amount of crew time (Refs. 2.63 and 3.45). In fact, the SL3 SPT "took a shortcut on the installation--and just grey taped it..." (Ref. 2.58).

Wear also occurred in the heel area (Refs. 2.40, 2.58, 2.66, 2.72, and 3.21). A teflon insert in the heel rubbed through the shoe canvas (Figure 21); grey tape remedied the resulting tears (Figure 22).

The SL4 SPT reported catching the triangle shoe heel in the grid while he rode the ergometer and tearing the canvas from the base plate at the heel (Figure 23) (Ref. 3.21). The SL4 PLT reported a failed shoe base plate when a film vault door hit his foot. Grey tape was used (Figure 24) to fix the shoe (Refs. 3.40, 3.41, 3.43, and 3.54). The SL2 SPT also failed a triangle shoe base plate under the instep about an inch from the toe (Ref. 1.52).

Several crewmen reported a need for backup shoes, particularly since so much wear was incurred. After the stitching came loose from part of his right shoe sole, the SL3 PLT reported:

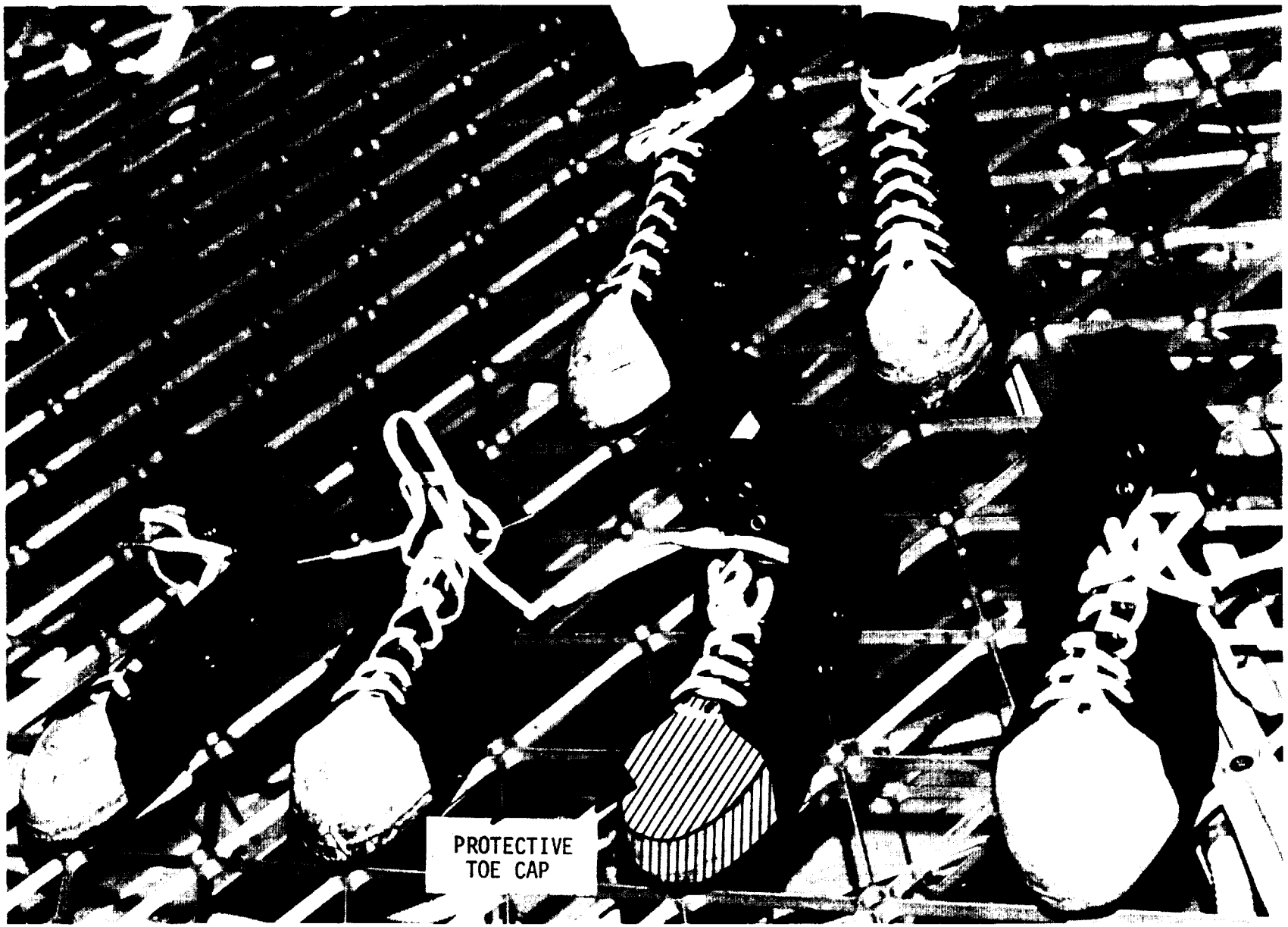


FIGURE 20: SL4 Triangle Shoes with Protective Toe Caps Installed

FIGURE 21: Triangle Shoe Wear (Above Heel)

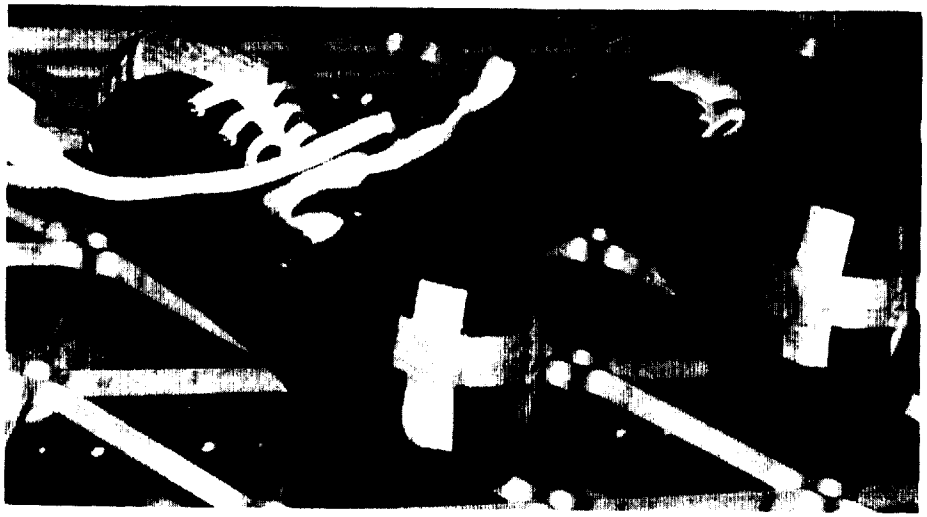


FIGURE 22: Shoe Wear Taped

FIGURE 23: Triangle Shoe Torn During Ergometer Activities

FIGURE 24: Tape Repair of Failed Triangle Shoe Base Plate

> "...by the time we get through the mission, [the shoes] are going to be pretty well worn. And they might even be marginal; I'm not sure as to whether or not we can make it with them." (Ref. 2.40, see also 2.50)

The SL3 SPT commented, "One pair of shoes for all the functions is inadequate." (Ref. 2.66); and the SL4 PLT, whose shoe plate broke: "It would have been nice to have a backup there." (Ref. 3.45, also Ref. 3.52).

Although not used to the degree the triangle shoes were, the soft boots also received some wear (Refs. 1.9, 1.20, 1.46, and 1.54), primarily in the toe area.

Snaps/Attachments

The Skylab garments had two sets of snaps/attachments:

(1) The snaps on the trousers and jackets which were to interface with each other to prevent garment migration and the wall snaps for temporary stowage. The location of these snaps is described in the section, "Skylab Design" presented earlier in this report.

(2) Communication lead restraints which were elasticized strips to retain the lightweight headset crewman communications umbilical. These restraints are described in the "Skylab Design" section above.

In general, the snaps were used as a function of personal preference (Refs. 2.58 and 2.72). However, the presence of the center back snap on the jacket (as well as the center back button on the hypotensive pressure garment worn for re-entry) was a problem during re-entry and landing: as the "g" forces built up, the snap pressed on the spine (Refs. 2.55, 2.56, and 3.14).

The communications restraints were seldom, if ever, used (Refs. 2.66 and 3.51). One crewman suggested providing clips on the comm line which could attach to the garment, as required, and deleting the comm restraints (Ref. 2.66).

Several crewmen adopted the methods of tethering a checklist to their trousers for rapid and easy access to required

documentation (Refs. 2.14 and 2.53). The larger books would not fit in the pockets. The SL2 SPT carried the knife on a tether attached to his trousers for convenience and positive restraint (Ref. 1.46). For carrying miscellaneous items around, a zip-on pouch that would attach to the trousers was suggested as an optional item (Ref. 3.49).

Head/Hand Protection

Skylab provided a bump hat for head protection and IVA gloves for hand protection. The bump hat, described in the "Skylab Design" section above, was only used for M509 (Figure 25) and T020--the two maneuvering unit experiments--although its use had been outlined for other activities (Refs. 1.55 and 3.56). However, although the crewmen never reported bumping their heads (Ref. 2.31), "many head knockers" were reported in the MDA/STS area (Ref. 2.22); furthermore, the SL4 SPT reported:

> "Individual crew acrobatics might have been a good place to use [the bump hat] because if you were ever going to hit your head on anything, that was the time." (Ref. 3.56)

Evaluations of the IVA gloves for hand protection varied with the individual and the specific tasks he performed. Although the head received few bumps, if any, one "thing you do do [sic]," reported a crewman, "is skin up your fingernails and knuckles all the time." (Ref. 2.31).

During the SL2 initial entry into the Orbital Workshop (OWS), gloves were worn for protection against the hot OWS hardware (Refs. 1.2, 1.27 and 1.38). During the missions, gloves were periodically worn for Scientific Airlock (SAL) experiment operations requiring rod retraction:

- "[The gloves] are a necessity...the near rods weren't so cold, but the far rods were extremely cold." (Ref. 1.24)

- "...you [surely do need to use gloves] or you are going to leave skin on them [the rods]." (Ref. 1.53)

The gloves were used also for other activities. The SL4 SPT reported that handling the urine return container and trays "without those gloves would have really been hard to do."-- (Ref. 3.56). "I should have taken a picture of my hands after I got through doing the servicing in there...," remarked the SL4 PLT, who serviced a liquid gas separator--making and

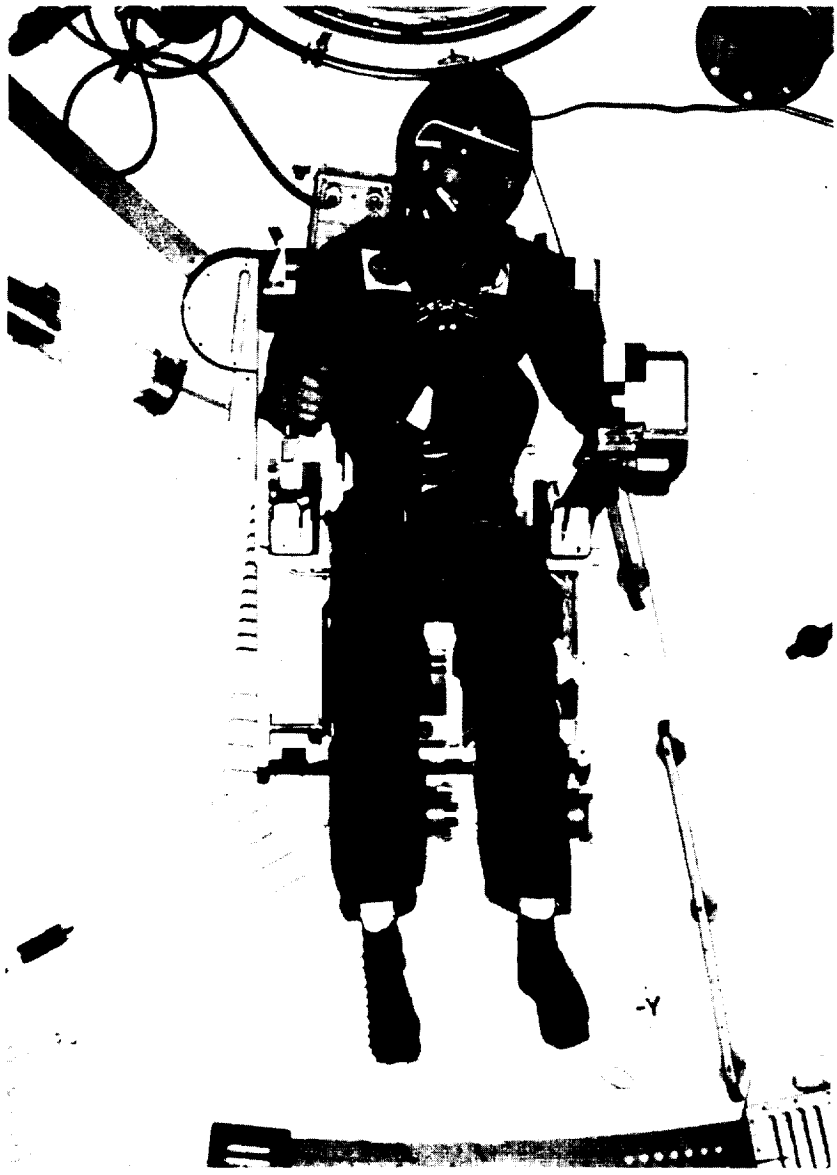


FIGURE 25: Skylab Bump Hat In Use for M509

breaking quick disconnects (QD's)--and noted, "I should have used work gloves. It was just a sorry place to work..." (Ref. 3.60). He added, "I sure could have used some work gloves in many places."--(Ref. 3.56).

Use of gloves for thermal comfort is addressed in the "Thermal Qualities" section.

Disposal

A laundry system was too costly for inclusion on-board Skylab; hence, all garments were to be disposed of through the TAL when deemed dirty by the wearer. The crew of SL3 was the first to report utilizing discarded garments as rags (Ref. 2.27, see "Non-Wear Garment Use" section). Only the cotton items were used a rags (Ref. 3.56), and these were used primarily for housekeeping tasks (e.g., wiping up spills). No wet items were left in the rag bag but were disposed (Ref. 2.34). The SL4 crew continued this procedure.

The rag bag was a Skylab disposal bag, shown in Figure 26 (Ref. 2.47). A crewman demonstrates disposing garments in a disposal bag in Figure 27.

Aesthetics

Only one crew commented on the appearance of the clothing--the SL4 crew which flew the longest mission. Varying the color of garments, rather than seeing only the "drab brown" would have been an improvement not only for the garment system but also for the general habitability of the Skylab vehicle (Refs. 3.49, 3.62, and 3.63).

The brown color had resulted from materials requirements for flammability and off-gassing as well as from dyeing limitations of the woven durette. However, a suggestion was made to vary the color of the cotton T-shirts (Ref. 3.23).

EVA-Related Garments

This report was prepared to discuss the experience gained from Skylab concerning garments. The emphasis has intentionally

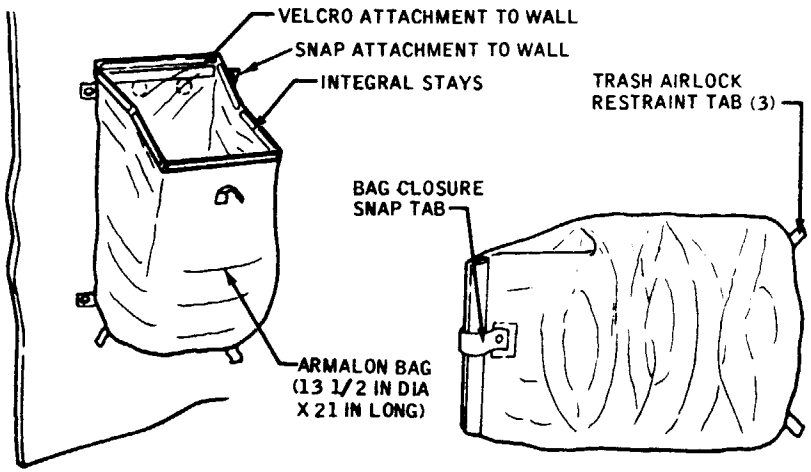


FIGURE 26: Skylab Disposal Bag (Rag Bag)

FIGURE 27: Disposing Worn Garments Through Trash Airlock

been placed on the IVA clothing only; however, a few general comments relative to the major EVA-specific garments seem appropriate for inclusion:

(1) Donning the upper half of the pressure suit was difficult in zero-g and required two crewmen. The absence of gravity to help pull the upper torso down for suit insertion was readily noticed. Additionally, the donning was apparently compounded by the crewman's 2-inch-average height increase (Refs. 1.26, 1.40, 1.55, 2.45, 2.60, 3.19, and 3.33).

(2) Closing the donned-suit zippers was also a problem, primarily due to the loss of gravity-induced "settling" of the crewman into the suit and of the upper half of the garment "settling" onto the lower half (Refs. 2.45, 2.60, and 3.19).

(3) There was little moisture in the suits immediately following use. Drying the suits was no problem, and the suits stayed relatively clean (Refs. 1.42 and 2.61).

(4) After the suit gloves were donned, the crewmen found the zippers on the pockets hard to handle to access the pockets (Ref. 1.18).

(5) For one of the SL2 EVA's, the crewmen taped items onto the suit within the reach envelope for EV transport (Ref. 1.43).

CONCLUSIONS/RECOMMENDATIONS

1. The multi-garment Skylab wardrobe (i.e., shirt, jacket, and trousers) was generally well accepted by all crewmen, particularly on the basis of thermal adjustability. The basic two-piece set (shirt/trousers) is highly desirable over a one-piece coverall type flight suit.

2. The importance of garments as tools to support crewman activities on a daily basis was emphasized. Furthermore, pocket design (including size, location, closure methods, etc.) seemed to be a critical factor in the efficiency and effectiveness of the crewmen.

3. Zero-g physical effects on the crewman are significant in terms of garment fit. The decrease in waist size and increase in stature were the two most relevant body changes having impact on garment sizing/fit for future space crews.

4. Utilization of "dirty clothes," especially absorbent materials such as cotton, should be considered as rags for general clean-up/housekeeping tasks. Disposal or repacking laundry (and rags) should also be addressed.

5. Excluding food spills, soiling of garments comes primarily from the wearer's body; hence, a daily change of underwear, including shirt, shorts and socks, is highly recommended. Outer garments (i.e., jacket or trousers) can be worn comfortably for longer periods of time (e.g., two to four weeks depending on item/material).

6. Footwear received the greatest punishment in-flight and should be made of abrasion-resistant material. Particularly at the toe, protection devices (such as the Skylab toe cap) should be incorporated to prevent wear. Internal shoe inserts, soles, ribs, etc. that are rigid should be designed to prevent shoe wear from the inside.

7. Gloves should be provided each crewman for thermal comfort, thermal protection, and abrasion protection. Head protection provisions should be based on safety requirements, task requirements, and architectural considerations.

8. Garment aesthetics and overall appearance should be improved as a means of enhancing not only the personal garment acceptability, but also general vehicle habitability.

9. Cuff inserts which can be optionally removed in-flight should be provided in long-sleeves and legs. The inserts should be a loose enough knit to accommodate watches, dosimeters, or other paraphernalia worn on the wrists or ankles. Ankle cuffs should not hinder trouser donning over shoes.

10. Facilitating shoe donning and doffing should receive increased consideration to help alleviate the problem of holding a hand-to-foot position for lengthy periods (e.g., for tying shoe laces).

11. Launch packaging methods should be improved to relieve the difficulties of garment removal from stowage early in the mission.

12. A closet-type overnight stowage area should be provided for garments to be worn the next day.

13. An absorbent disposable shirt should be provided for wear during exercise periods to absorb perspiration.

14. Providing a garment system palatable to all crewmen can best be accomplished by providing design options to accommodate personal preferences for items such as those listed below; these should be accommodated as much as possible since providing these types of design options appears to be satisfactory to most, if not all, crewmen:

    a) Variable modes of dress (e.g., removable trouser legs

    b) Footwear options (e.g., triangle shoes, soft boots)

    c) Use of snaps and/or cuff inserts on garments

    d) Underwear styles

    e) Pocket style options

15. Materials restrictions should be reexamined to determine acceptability of wearing garments, such as standard T-shirts, as outer wear items.

16. A standard-size system for all garments should be adopted to minimize cost and allow ready garment access for a larger population of crewmembers.

17. Off-the-shelf garments should be utilized for garments such as underwear to reduce the garment system development costs and make these items readily available to a larger crewmember population.

RAW DATA APPENDIX

REFERENCE	SOURCE	PAGE
1.1	SL2, TAG Tape 146-13/1	A-6
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1.7	SL2, TAG Tape 151-12/6	A-7
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1.38	SL1/2 Technical Crew Debriefing, June 30, 1973, JSC-08053, pp. 5-10, 11	A-17
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1.42	SL1/2 Technical Crew Debriefing, June 30, 1973, JSC-08053, p. 17-6	A-18
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1.46	SL1/2 Technical Crew Debriefing, June 30, 1973, JSC-08053, pp. 18-6, 7, 8, 9, 10	A-21
1.47	SL1/2 Technical Crew Debriefing, June 30, 1973, JSC-08053, p. 18-12	A-23
1.49	Skylab Mission Report, First Visit, JSC-08414	A-24
1.50	SL1/2 Corollary Experiments Debriefing, July 5-6, 1973, JSC-08082-3, pp. 19-21	A-25
1.52	SL1/2 Corollary Experiments Debriefing, July 5-6, 1973, JSC-08082-3, pp. 63-64	A-27
1.53	SL1/2 Corollary Experiments Debriefing, July 5-6, 1973, JSC-08082-3, p. 162	A-28
1.54	SL1/2 SWS Systems Debriefing, pp. 1-2	A-29
1.55	SL1/2 SWS Systems Debriefing, pp. 6-13	A-30
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1.57	SL1/2 SWS Systems Debriefing, p. 136	A-34
2.1	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, p. 275	A-35

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2.2	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, p. 278	A-35
2.3	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, p. 456	A-36
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2.28	SL1/3 Onboard Voice Transcription, October 1973, JSC-08477, pp. 1495-1496	A-46
2.29	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, pp. 2313-2314	A-47
2.30	SL1/3 Onboard Voice Transcription, October 1973, JSC-08477, pp. 1525-1527	A-48
2.31	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, p. 2510	A-49
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2.37	SL1/3 Onboard Voice Transcription, October 1973, JSC-08477, pp. 1839-1840	A-54
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2.42	SL1/3 Onboard Voice Transcription, October 1973, JSC-08477, p. 2141	A-58
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2.51	SL1/3 Technical Air-To-Ground Voice Transcription, October 1973, JSC-08476, p. 4585	A-64
2.52	SL1/3 Technical Crew Debriefing, October 4, 1973, JSC-08478, p. 0-4	A-64
2.53	SL1/3 Technical Crew Debriefing, October 4, 1973, JSC-08478, pp. 5-3, 4	A-65
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2.65	SL1/3 Technical Crew Debriefing, October 4, 1973, JSC-08478, p. 23-38	A-72

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.66	SL1/3 Corollary Experiments Debriefing, October 16, 1973, JSC-08482, pp. 15-22	A-73
2.67	SL3 SWS Systems Debriefing, p. 58	A-77
2.68	SL3 SWS Systems Debriefing, p. 106	A-77
2.70	SL3 SWS Systems Debriefing, p. 108	A-78
2.72	Skylab Mission Report, Second Visit, JSC-08662, pp.10-17, 18	A-79
3.3	Skylab 1/4 Onboard Voice Transcription, March 1974, JSC-08809, p. 171	A-80
3.5	Skylab 1/4 Onboard Voice Transcription, March 1974, JSC-08809, p. 515	A-81
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SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

18 31 25	CC	Skylab, Houston. We're about 1 minute from LOS. Goldstone coming up at 35.
	CDR	Roger. Do you still want us to stay off the DAS?
	CC	Okay, you can clear the caution on your ACS malf, and we'll be standing by for Goldstone for the DAS checks.
	CDR	Okay.
18 35 10	CC	Skylab, Houston through Goldstone for 6 minutes.
	CDR	Hello.
	CDR	Hello, Houston. We hear you.
	CC	Okay. Read you loud and clear.
	PLT	Hey, Houston; PLT.
	CC	PLT, go ahead.
	PLT	Okay, on our fairly quick inspection the OWS appears to be in good shape. It feels a little bit warm, as you might expect. From the 3 to 5 minutes I spent in there, I would say, subjectively, it's about - it's a dry heat. I'd guess - It feels like - like 90 to a 100 degrees in the desert. Hank, I could feel heat radiating from all around me, but in the short time I was in there, I never felt uncomfortable. I had the soft shoes and the gloves on, and nothing I touched even felt hot to me.
	CC	Roger; copy.
18 36 44	SPT	SPT, are you ready for those DAS tests?
	CC	That's affirmative.
	SPT	Okay, I'm going to give you 10,000. Please acknowledge.

Ref. 1.1

A-6

	CC	Roger. I'm reading you loud and clear, Pete.
	CDR	Okay. I got you on the speaker box - ouch! It's hot down in here - ow - OWS. Yes. I got my hot gloves back on again. The speaker box is about 130. We're taking the tape off the box, and we're taking our time right now; and if we have any questions on the procedures, we will wait to ask you.
	CC	Roger. Copy.
21 57 46	CDR	The certain question I had was, why did you re - want to reverse the sleeves on the SAL tripod?
	CC	Say again, Pete?
	CDR	On the SAL tripod, why did you reverse the sleeves on it? And I just couldn't figure out why on the tiedown.
	CC	That's the - that's the screws that - the way the thing is mounted, there for launch, Pete. You know, you turn those around, on the - where - as part of activation.
22 00 04	CC	SPT, Houston.
	CDR	He's down in the workshop.
	CC	Okay. SPT, just give us a call when you're free for a minute.
	CDR	Can I relay you, Hank?
	CC	Negative. I just got a little task I want him to perform here sometime when he's free. And I need to read it to him whenever he's got a chance to listen.
	CDR	Okay.
	CC	Skylab, Houston. For information; no action required. We're going to do another nominal M-cage in about 2 minutes.

Ref. 1.2

PLT Okay, I'll tell him.

CDR I got it.

CDR I'll tell you, Crip, when I get back and leap out of the bed in the morning, straight towards the ceiling, and grab my pants and dive back into them before I hit the overhead, and I really find myself lying flat on the floor, and then I'm going to know I'm back.

Ref. 1.6

CC Roger. You're going to have a hard time explaining that one to Jane.

CC And, Skylab, I was still waiting to get the morning news for you, which I haven't received yet. You might be interested to know that Gordon Johncock won the Indy yesterday, and it only went 132 laps, that they had to call it after rain.

CDR Understand. And, Crip, I understand that there are a few guys over in our office that don't believe that we can run around the water wing lockers; so we're willing to take a small wager from any of them that really don't believe that. Furthermore, to sweeten the pot, last night in our training session done after 03:00, I might add not on company time, we also added a little fling to it, where we now can run around the water ring lockers into front flip and back flip. So, if they want to sweeten the pot before we show you this publicly on TV, we're willing to take any wagers.

A-7

CC I'll see how many takers you have.

CC Skylab, Houston. I've got some sad news in this morning's paper that the blob is dead. I'm sure that Joe will be glad to hear that. And they killed it with nicotine.

MS (Laughter)

SPT I'd like to be the blob.

23 39 06 CC Roger. We're still listening, Pete. And we've got about 2-1/2 more minutes left.

23 39 14 CDR Okay. Further, I - I was hacked by 23:00 tonight because it's 19:00 until 23:04, to finish everything on time, including inhibits. I had alarm clocks going off in my pocket, and, if you'll look back over my Plan, I've been whistling all over this spacecraft today. And I got it all done only to get up here at 23:00 and get a bunch of bologna you could have sent on the teleprinter. And you guys missed the housekeeping Golf which I had been shooting for all day just because I said, "I'm going to get it all done. I'm going to get it all done and I'll beat those guys ontime." Now, part of that problem with S019. Part of it was the SAL. Part of it was that first pass was way too long. I got it all done, but I got it done poorly by only doing two of the reference stars and running the four photographs. And it turns out that, when I did the last reference star, which was in daylight, by the way, that it - to check the reference, the reference was off when the first one had been on; and, therefore, I don't know what the other two are. So I suggest that, to do S019 correctly, that we take one whole night pass, and do nothing but send up four references to check, to check the four quadrants so we can do a very precise, very accurate job on that and get the data back to Carl so that his experiment gets done right. Are you still there?

Ref. 1.7

23 40 46 CC Affirmative, Pete. We've still got about a minute to go this pass. Tell you what, Pete, why don't we - why don't we secure listening to your or - your summary here. We'll be more than happy to keep listening here at the Evening Status Report. But, I hate to cut you off in the middle. We've got about 50 seconds left. The next pass is Hawaii at about 00:40. And one of the things that I think we really - don't have a good feel for here on the ground, and we'd like to know is - is has the accumulation of the last week put in a requirement for - for us to give you any time just to get squared away in the

	CC	Okay. We'll get you an answer.
	SPT	Thank you.
	CC	And, Joe, thank you very much for the work on 172. That looks as if we finally got a good cal on that. Certainly appreciate that.
	SPT	My pleasure.
	CC	We've - there's still questions on clothes and such before we can get usable data.
	SPT	Roger. We noticed that our weights, as they were sent up by the medical pads this morning, were quite a bit higher than our onboard cal curve indicated to us. Are you guys using a fudge factor?
13 33 48	CC	Joe, I've had nothing to do with that weight. I don't know where it's coming from, or anything else.
A-8	SPT	Okay. I would be interested in the next few days, if the medical people could give me a correction to our cal curve or tell us whether it's any good or not - our onboard curve.
	CC	Joe, since I have you, could you tell me what you're wearing in the morning? Are you wearing the triangle shoes? We - this is the last big thing we need.
	SPT	Okay. Weitz is wearing the triangle shoes, and he's doing it every morning as a standard thing. Conrad and I are not wearing the triangle shoes. We're wearing our soft shirts and our trousers and socks.
Ref. 1.8	CC	Okay. I assume also underwear, and is this with the long pants or short pants, Joe?
	SPT	It's with - it's with pants. This morning it was with long pants for me; the previous 4 days was with short pants. Sorry about that, but it's taking me that long to acclimatize.
	CC	We copy that, and thank you very much, Joe. And we'll get you some good data up.

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

16 20 49	CC	Skylab, Houston; AOS Carnarvon, 10 minutes.
	CDR	Roger, Houston.
	PLT	Hey, Bill.
	CC	Go ahead.
Ref. 1.9	PLT	I was going to put this on B channel, but they just started dumping a recorder. Pass to the follow-on crews, will you, that I'm - the slip - the soft boots, the slip-ons, with the zippers up the sides, I've worn mine about 3 or 4 days; and you tend to try to poke your toes in things and under things and that - that I've about torn the toe off. The whole toe is worn out. So, if they think they want to wear them, they'll probably have to bring some extra ones up.
	CC	We copy that.
16 24 01	CDR	Hey, Houston; CDR.
	CC	Go, CDR.
	CDR	Think something was going down the crack here. Check something out for me. No, that's not right either. Oh, never mind I found it. Forget it. (Laughter)
	CC	Okay, Pete.
	CC	SPT, Houston.
	SPT	Yes, sir.
	CC	Your H-alpha 1 camera appears to be still running.
	SPT	Oh, yes. Okay.
	SPT	Did that do it, Houston?
	CC	We'll be with you in just a second, Joe. We're looking.

Ref. 1.10

	CDR	I'm going to start wearing my gloves. It's cold. I've ... platform for an hour. It's cold.
18 11 03	CDR	Back on the panel -
	CDR	... stop 11:40. Go to the checklist and check the list. Postoperate: S192 DOOR, CLOSED; close and latch S190. That'd done. Heater, OFF.
	CDR	I have the yellow light, says HEATER switch OFF. Okay. I got the DOOR CLOSED light on S192. Operate pad remarks. What do they say about S192? Anything? S191 now. Paul, are they put in here?
	CDR	Well, this says that my pads remarks, and that's not - Okay. Yes, yes.
18 15 40	CDR	Hello, friendly tape recorder for EREP. Charlie is ... 80 percent, 80 percent.
18 28 44	CDR	Hello, B channel, for EREP. The tape - the measurement on this ... left on the takeup reel is 2-1/8 inches. End of message.
18 33 59	PLT	Hello, B tape recorder, for EREP. The VTS site. The first site - wait - Okay, the first site, site 220, was acquired easily at max forward angle; a site near the Bonneville Salt Flats was acquired IN-TRACK; 415 could not be found for clouds - well, could not be found. I think clouds are a major factor. The same with 420 and 445, which is just a spot in the water. Make that a clear spot in the clouds and track that. And then, getting back on with what I was doing and getting back out, as I mentioned, drive is about 50 seconds late getting back onto the nadir swath. And started it about 410. A couple of words about that VTS. You have much resolution, things looks a little - I don't know - small things are small - hard to find in it. The small field of view is the biggest problem. I think if we ever build anything like this again, you really want to keep the ability to go to quite a bit larger field of view. End of message.

Ref. 1.18

21 41 54	SPT	The airlock is a - a fine tunnel. And for a tunnel and - and an airlock, it's size and dimensions are pretty good because when you're EVA with the hatch open you always have something to bear against, and I wouldn't want it a whole lot bigger - a little longer maybe, because we always have trouble getting things in. Okay, ceiling/floor proximity is good. Ingress/egress is good. We don't collect trash in there. Stowage volume: We should have a little more, a little better thought-out stowage for EVA. Equipment: The zipper pockets aren't very useful because you can't get anything in them and then close the zipper, and zippers aren't easy to handle in a pressurized glove. Keep in mind that Velcro is - would be great if we had the right kind. Snaps are also no good in the pressurized glove. Much of the Velcro on board the ship is no good because it doesn't hold well enough. Okay, personnel mobility aids are not required. Restraint devices, not really required. We talked at one time about having shoes in the airlock, and shoes are a great thing in a pressurized suit. We just don't happen to need them in a compartment this size. Comfort, noise level, and illumination are not applicable.
21 43 11	SPT	In the MDA/STS, general arrangement is reasonably good except for a couple of things. The M200 circuit breaker panels have always been a pain in the neck and, in zero-g, they continue to be a pain in the neck, orienated at right angles to everything else and on down. The bottleneck of the MDA is the STS, where the control and display panels are. It's not compatible to have a guy working there and a guy working at the ATM. And the guy at the STS blocks the hatch. Ceiling/floor proximity is all right. Ingress/egress is all right. Trash collection: Don't seem to need one in the MDA, and we don't have any - that I can think of. Stowage volume and access, okay. Equipment restraints, okay. Mobility aids, not required. Restraint devices: The two triangle sections are - are good. Illumination is low in the MDA and a little bit confusing in a circular compartment. Noise level and thermal comfort are - Well, noise level is okay. It's cold in there, and it has been for days.

compared to my two compatriots in that I was not able to sleep well in the sleep compartment because, surprisingly, I felt like I was sleeping on a wall. Apparently, I have a personal mental problem, I guess, but I've not slept in there since about the fourth night. We moved in the workshop, I slept in the forward workshop compartment. The volume is good, the ceiling/floor proximity is also all right, the ... are okay, trash bags are fine, stowage volume is very good. Temporary equipment restraints those towel holders are excellent. They are outstanding for that type of use, you use it to hold your clothing on, and it's excellent for that. Temporary equipment restraints quite a bit of - well, a couple of strips of Velcro would be adequate. Personnel mobility aids don't apply as do restraint devices. Thermal comfort is very good, noise level, very good, and illumination, adequate. Experiment compartment.

Ref. 1.19

23 54 28 PLT

General arrangement - it's a - let me think on this a minute. Somebody would think we'd do better - someone else would do better - evaluating, I think, when you're not used to it. We've been training in this thing for a year and a half, and some things you come to accept. I guess I get no comments to make, no suggestions, so I'd have to give that a very good, then. The volume is all right, ceiling/floor proximity is very good. Ingress/egress doesn't really apply, it's all right. Trash collection; you don't make much trash in there, and we haven't really found a necessity to - there are no trash collection provision and I guess, we haven't found a necessity for any. Stowage volume and access; the PSS drawers are kind of out of the way, I'd have to give that an adequate. They're out of the way, you have to go around the bicycle every time you want to get into something.

A-10

23 55 38 PLT

Temporary equipment restraints are okay. Personnel mobility aids: there are none. Restraint devices are ... Thermal comfort is - and noise - thermal comfort, noise level, and illumination are all very good. Now the forward and dome areas - I don't know what you really - what we really should be trying to answer in general arrangement and orientation. It's all one-g vertical, which is the way you get used to it in general arrangement. It's all right. The

02 13 04	PLT	- - the chair even with the ...
	CDR	...
	SPT	How comfortable are your ...
02 13 18	SPT	Hot coffee!
	CDR	(Laughter)
	PLT	Very good. (Laughter)
	SPT	... hot coffee.
	SPT	Were they sufficiently ...
	CDR	Clothes! Darn it! Yes, I got - we got clothes running out of our ears.
	PLT	... except for the triangle shoes ...
	CDR	Triangle shoes and the other shoes, both of them are not holding up.
	PLT	The toes are unbraiding. They're wearing out because you use your toes a lot. You drag your toes over the ... to slow you down and - It's like a brake on a wagon. You drag your right foot if you want to swerve to the right a little bit.
02 14 01	CDR	Not only that, but it is a pain in the neck, to me, taking these triangle shoes off and on with all the laces. I'd like zippers on - something else on them -
	SPT	I think I'd ...
	CDR	Yes, I also ... to heck with the Hushpuppies. I thought that the kind of hard ...
	SPT	Would you still like ... laces ...
	PLT	Yes; okay. That's my point.
	CDR	No, wait - you're - are you justifying laces because you like laces or because you thought they were the best thing for support?

A-11

Ref. 1.20

	SPT	It's the best thing for support.
02 14 35	CDR	Well, you ought to specify support ...
	PLT	... we ought to get zipper ones. ...
	SPT	Okay. But the laces are not ...
	CDR	...
	PLT	... terrific recommendations for the clothes.
	SPT	... big objection ...
02 14 57	CDR	Well, there's one - there's one thing that I - I - The only long sleeved thing that I have is this jacket. And I would prefer a - a lighter shirt that had long sleeves. We've gone through some pretty ... temperature ranges. ... never high humidity ... from oscillating ... about 58 in the MDA and about ...
	SPT	Okay. ...
02 15 51	CDR	Oh, I think there are very few tabs that are ... that we didn't anticipate.
02 16 00	PLT	... you do ask other people to help you. ... quite clear ... wardroom.

END OF TAPE

CDR Uh-huh. Don't worry, we find plenty of to keep ourselves busy with.

CC What I meant was, one investigator might be casually requesting another investigator to give up a bit of time, this sort of thing.

CDR I see. Well, you know, it's sort of like Joe and Paul were good boys tonight, so I let Joe have the command module, and Paul has 509.

CC Copy.

CDR The PLT spends his spare time lookin, for new places to sleep.

CC Have you tried letting him sleep strapped in the 509 yet?

CDR Yes, Hank, we're ready to charge the batteries and the bottles on 509. We got it all activated last night.

A-12

CC Your translation modes up there are pretty interesting. I had predicted legs weren't always going to be too useful there. And I noticed that Joe seems to keep his pretty well tucked up under him

Ref. 1.22

CDR Everybody sort of has their own way of going, and it - it depends on what you're doing. Now, Joe likes - when he's working and he's got to be held down, Joe uses the lollipop. I've stuck strictly with the triangle shoes, depending on the task, or I wear my slippers - shoes. It's dependent on what I'm going to do. I run the ATM, I don't need the triangle shoes. So, We - we've got all kinds of different ways of trying to do it - doing his own thing. But, essentially, I think the most important thing is - is that all of us can do all the tasks, and we really don't have too much trouble doing them. As I said earlier and it still applies, if it's got a lot of little pieces that you've got to hold on or keep track of a lot of things, it - it slows you up a little bit. But that's - that's the only difference up here than down there. We've adapted very well. Everybody - well if you're just resting, we just free float and wind up wherever we wind up, in the ceiling, on the floor, over in the corner, ricocheting off the walls, and it doesn't seem to bother us.

CC Roger.

PLT Hello, Houston. You there?

CC Roger. WE got about 1 minute left.

PLT Okay. Something for the S073 guys to think about. According to our calculations, S073 is not going to finish the program it's in right now before it has to be secured to - to put the other rods on.

CC Okay. We'll take a look at that.

PLT Okay do you want us to do it? I tell you what - Pete said he ran it out at 01 something. According to our onboard procedures book, that takes 10 revs to complete that, and so that's not going to be done for another - It's only been 10 hours now; it's only two-thirds of the way through, I guess, - something -

11 17 38 CC Okay, we'll work that. And we're about 10 seconds from LOS. Bermuda will be coming up at 22.

PLT See you.

11 21 59 CC Skylab, Houston through Bermuda for 9-1/2 minutes.

CC And, Skylab; Houston. In answer to the question on the S073, we plan to terminate that program early. And it's in the remarks section of message 170, it talks how to terminate it by cycling the power off.

SPT Roger.

CDR Thanks, Hank. We just hadn't quite made it all the way through the 22-footer you sent us last night.

CC (Laughter) Roger.

Ref. 1.23

CDR That's the only trouble with that. I wish there was some way you could get those early morning remarks, like "inhibit momentum dump" - any of that stuff that's in PSA. And we really hussle it to find it in the morning, you know? And I don't know what you can do to work on that, but the flight planners might think about it. I'd sure appreciate the details on the - in the - things that you want during the FCA the night before, if possible. Because it catches us with our pants down every time.

	CC	Okay. I don't think it's worth a special trip. But get all that information for time line purposes.
	CDR	Well, we like zinging up and down in the spacecraft.
21 43 55	CDR	Say, Crip. It's 0.5 right now. It's been about 20 minutes. And I might be a little suspicious of the gage.
21 44 06	CC	Okay; 0.5 after about 20 minutes. And for your information, wiping down and stowing of the rods is okay. We're 1 minute from LOS, and we'll have you again at Gaum at 22:23; 2223.
Ref. 1.24	CDR	They weren't kidding about that stuff getting cold, I'll tell you. I had my gloves on when I started to bring them in and I thought that's kind of foolish, so I got them out a second time and, man, they were really cold the further I went.
	CC	Roger. Understand the gloves are recommended?
	CDR	Yes, sir. They are a necessity, and I had them on to start with. It wasn't bad until I got about two rods in and how cold it was going to get because the near rods weren't so cold, but the far rods were extremely cold.
	CC	Roger. Thank you.
	CC	Skylab, we have sent the Flight Plan up. We had some problems with transmission. Like you to check and see if it looks okay, and tell us on the next pass whether we need to send it again.
21 45 15	CDR	Okay.
22 23 55	CC	Skylab, Houston. We're AOS over Guam for 3 minutes.
	PLT	Roger.
22 24 36	CDR	Hey, Crip. We just finished welding the second wheel on M551?

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

01 00 03	CC	Okay, Pete, I'm sorry; you answered that one last night and that's the remaining five that we're after.
	CDR	Go ahead with the next one.
Ref. 1.26	CC	We are presently assuming that lunch will be eaten with suits off in the OWS between EVAs, and you also confirmed that yesterday.
	CDR	I confirmed that we probably would not take the suits off. It's too much trouble.
	CC	We're going LOS here. We'll have you again at Honeysuckle at 01:04.
	CDR	Okay.
01 04 37	CC	Skylab, Houston; AOS for 4 minutes.
	CC	PLT, Houston.
	PLT	Go.
	CC	We need a STOP on S052 and STANDBY. POWER.
	CC	Skylab, LOS in 45 seconds. We'll be AOS - AOS Canary 01:52 in med conference.
01 58 35	SPT	Was that LOS, Houston?
	CC	Negative, Skylab. We still have about eight minutes here.
	SPT	Okay, our poor surgeon got cut off prematurely there.
	CC	Want us to try to get him back on for you, Joe?
	SPT	Yes, would you please, Bill?
	CC	Wilco.

11 24 51 PLT

Hello, friendly tape recorder; it's the PLT with the 477-3 this day, evaluating the frequency of use. Okay, starting with the jacket; used it almost daily. You got to keep in mind we're in a little off - nominal situation, although we're basically nominal, that is, with MDA heaters on. There was a span of about 2 or 3 days ago which - the middle of which was about 3 days ago. The span of 2 or 3 days, the middle of which was about 3 days ago, then which MDA was warm enough that the jacket was not required. However, there was before that, and as it is now, we're - have the MDA heaters off in order to help keep the workshop temperatures down. Therefore, it is warm in the workshop and chilly in the MDA, and a jacket is an extremely useful item. The IV boots, I prefer them - much prefer them to the triangle shoes, and wear them every day at every opportunity, but I do not require the triangle shoes. The IV gloves I have only worn one time, and that was on our initial entry into the hot, hot workshop when we were handling the extensions on the sail. I have not used them since. The bump hat has not been out of its locker. The pillow on the sleep restraint; sometimes I used it and sometimes I don't; I haven't really decided. Blankets, I have not used at all. The light baffle I have not put up, since I have not been sleeping in my sleep compartment; same with the privacy curtain. Penlight is used almost every day and carried at all times. Scissors is used every day, is kept at the meal table and that's where it's used - mostly, almost exclusively, is used for opening food packages, and also for trimming the teleprinter messages. The tool caddie was used during activation. I found it fairly handy at the time; it has not been used since. I don't miss it. The portable fan - we have used the portable fan. It goes along with the - my time estimates on when the MDA heaters were on. When the workshop was cool at low Beta angles, we took it down for 3 or 4 days; it is now back up. We have one portable fan mounted in the workshop dome opening, directing warm workshop air onto the OWS heat exchanger inlet. We have used the portable fan each time. The tape player, we could not get by without it. We used the one in the wardroom, although not as much as we did in training. The one that gets used the most, by me, is the one that we have - one of the sleep restraint tape players that we've plugged

Ref. 1.27

A-14

direction, and they're not large enough. The wardroom window is nice and large; however, now that we are at high Beta angle, it's looking out at the southern horizon. We cannot see below us out of that window anymore, and besides, that window has a big spot in it now, as you are probably aware. And we need - we ought to have bigger and more - more windows like the wardroom window in the workshop. STS windows are - they're very good; however, they - they are kind of small and they're obstructed very much by external stuff to the vehicle. That's all, thank you.

11 33 22 SPT

Friendly tape recorder, this is the SPT, with M487-3 subjective evaluation of the following items for frequency of use. The jacket is used daily, every other day, depending on how long I'm spending in the MDA, the cold part of the vehicle. It's not on all the time, and I wouldn't be without it. I use the IV boots very seldom. I haven't used them for 2 weeks. Use the triangle shoes all the time. The IV gloves, I haven't even found. The bump hat, don't know where it is. Use the pillow all the time; however, I do not very often use the little knit thing that flips over your head. I've evaluated it, I haven't decided whether it's use - useful or not. Use the - the thin blanket all the time - the one you crawl in through the neck of - all the time except the first 4 or 5 days, when it was too hot to use. I have - I have not used the other blankets, except the bottom blanket I zipped up a couple feet on one occasion when it got down to 72. I have not used the light baffle; use the privacy curtain every night. Use the penlight daily, not very frequently and for long periods of time, but daily; for instance, to go to the bathroom at night. In the early morning looking at the PRD's to read them, you need a good light locally and earlier in the mission when we were conserving light, I used the penlight frequently. Use the scissors daily for eating, for M133. The tool caddie I used during activation, have not used since; probably will use during deactivation. The portable fan, we're using the one portable fan because of our thermal problem. Other than that, they're not required.

Ref. 1.28

12 21 37 CDR

Hello, friendly tape recorder. This is the CDR on day 167, 16:30, M487-3 Charlie. Items to be evaluated: Jackets. Jacket was used daily, especially in the MDA and the command module area, where the temperature ran around 60 degrees. I use the IV - IV boots daily when I did not need to be restrained in the floor again when operating the ATM, or sitting around the wardroom, or working in areas where restraint to the floor was not necessary. I found no reason to use the bowpad. The pillow I used in my bed could, by raising the straps on the bed in such a manner that it didn't - the natural edge to my body - put my head against the pillow. The blankets I used during the middle of the flight when the workshop got down in the low 70's, but otherwise, I didn't need the blankets after that. The light baffle I put up, and I did read in my bedroom, and I kept light out of the ..., and also we ... And I believe it helped. The privacy curtain I used only on occasion when other crew members were up and I wanted to sleep, which was very seldom; we normally all went to bed at the same time and turned the lights out. The penlight was a daily necessity that was used all the time throughout the vehicle. Scissors we used as a daily necessity at all meals, and we also used them to cut up teleprinter pads and other things. The tool caddy I did not use; I found my pocket good enough. We normally returned something after use. So just to transport it, I can simply carry it in my hand, use it and put it away. The portable fan we used in the OWS dome to blow OWS hot air during our hot portions on heat exhanges; in the airlock module, that worked pretty well. Tape player I use daily in the ATM, in my bedroom, wardroom; the headset I use daily, also every evening, so that I wouldn't put my music on somebody else's ears after lights-out or you're going to read, or something like that. The microphone I've had no occasion to use.

Ref. 1.29

A-15

12 23 53 CDR

Playing cards I have no occasion to use. I don't play cards on the ground, and I don't play cards up here. Books - I've read two and a half books so far in the flight for pleasure in the evening or off-duty time. The hand exerciser I didn't feel that I needed. I don't use one on the ground, I don't need one up here. The handball we threw

	CC	SPT, Houston. The DAS is yours once more, and we need you to enable the dump for us please, sir.
	SPT	Okay.
09 48 52	CC	Skylab, Houston. We're 1 minute from LOS. We'll see you again over Carnarvon at 10:13; 1013. And we'll be doing a data recorder dump at Carnarvon.
09 49 03	PLT	Roger.
10 12 37	CC	Skylab, Houston. We're AOS over Carnarvon for 9 minutes. And we will be doing the data recorder dump.
	CC	PLT, Houston.
	CDR	He can't come to the phone right now, but whether we got it into two rods, he gave it a good shake. And whatever was hung up, unhung itself; and he got it manually to 0 TRUNNION, 040 SHAFT. And it's in, and he's taking it down.
	CC	Very good; solves all of our problems.
	CDR	There you go. Stick with us, kid.
	CC	Roger. Can fix anything.
	CDR	Meanwhile, the Betsy Production TV Company is still at it.
	CC	Roger.
10 15 20	CC	PLT, Houston. Regarding your question as to which star field to do first. If you're short on time, we'd like you to go ahead and take the first star field first. We assume that you shouldn't be in too much of a time constraint, though.
	PLT	Yes.
	CDR	I hope my demonstration of how triangle shoes work is sufficient.

A-16

Ref. 1.33

	CC	I'm sure we'll enjoy it.
	CDR	Hey - Hey, Crip. I'm not going to give a demonstration of the little balls on the toes of the feetsies because I don't use them, and I don't have time.
	CC	Copy.
10 18 53	CDR	Tell them it's strictly personal preference. Joe likes his; uses them all the time except when he's riding the bike because you got to use the triangles. And I think Paul and I both use the triangles all the time because it was just easier than changing about.
	CC	Roger.
10 28 20	CC	Skylab, Houston. We're AOS over Guam for 6 minutes. Sorry about that missed call for LOS.
	CDR	And, Houston; CDR. On TV-15, I'm going to skip the shower and then the TV tour 1, which has no voice. They didn't want voice, anyhow. And I've expended more than enough time on this thing already; like an hour and 20 minutes.
	CC	Okay.
	CDR	You got three ... triangle shoes, and the other two items that were asked for in the list this morning: suit stowage and locker doors. And that is it.
	CC	Roger.
	SPT	Houston, SPT.
	CC	Go, SPT.
	SPT	The S056 special troubleshooting procedure has just been completed. And the two sequences were completely nominal.
	CC	Roger. Copy. Both nominal.
	CC	CDR, Houston. Since you've completed your TV, we're going to go ahead and start rewinding so we can do our dump at Goldstone.

CONRAD (CONT'D) tank, and I think we got the little condensate system running first.

WEITZ But that's not what is condensate system activation. Condensate system activation is hooking the hose to the holding tank and just turning the valves on the condensate.

CONRAD You had to pull a vacuum on the big tank first.

WEITZ But that's not part of the thing that's labeled condensate system activation. Condensate system activation in the checklist comes after tank relocation and holding tank prep, which includes pulling the vacuum. Why don't we go ahead right now and talk about moving the tank. We did that out of sequence to get it out of the way of the airlock. It was a nothing, a piece of cake. It's the biggest blivet we had to move, and it went the simplest. Those blue restraints for your knees worked great.

A-17

CONRAD Joe, I guess you put the EVA hatch window shield in. It's in there now, and there's no reason for anybody to mess with it.

Ref. 1.38 We just took our time with the parasol and worked per checklist. We had to pop in and out of there to cool off about every 15 minutes. It was pretty hot. We used our gloves and we wore our jackets and our coats and it was extremely dry air, so other

CONRAD (CONT'D) than the fact you were just beginning to build up heat, it was kind of funny. It was extremely hot in there, but it really wasn't bad working in there. And if you just popped up to the MDA for about 4 or 5 minutes, or even less, you'd cool down and be ready to go right back in there again, and you could work for 15 or 20 minutes.

WEITZ I tried it for a while without my jacket. Actually, your jacket served as a thermal barrier against the radiant heat from the walls. I took my jacket off and, after 15 minutes or so of that, I put it back on. It's more comfortable with the jacket on, which is documented, I think. The only oddity we had was the Teflon flaps on the end. They weren't right.

CONRAD We had to reorient those Teflon flaps. It was not packed right.

WEITZ But we received real-time clarification from the ground on that. That was a prime example of somebody having done it on the ground. Obviously Hank Hartsfield had done it, and he happened to be CAP COMM at the time. He had the answers right away, so there was no delay in getting that clarified and squared away.

CONRAD You might talk about what you saw, Joe. I'm still not clear in my mind, even after looking at that thing on the flyaround, exactly what's not deployed right. I almost had the feeling that two of the poles on one side, a front one and an aft one, aren't deployed right, but I can't swear to it.

16.0 EMU SYSTEMS

CONRAD I think we've all commented on the excellence of the PGA; the fit and operations. I have absolutely nothing to add except the word, super.

WEITZ None of the suit techs commented on the back of my suit being too short when I got fitted at the factory. It became more evident in flight. I had a lot less length in the back of my suit than you guys did. It was just difficult to get that outside zipper up.

Ref. 1.40

CONRAD There's no doubt about it. You just can hardly pull yourself over far enough in zero g to get your head in and out of that suit. We had a two-man wrestling contest trying to get him in a suit. With Paul's tight fit in the back, it was definitely a two-man operation up there.

A-18

Biomed instrumentation worked fine until you put all that stuff in it. LCGs were good. I'm still mad about the biomed fit on the LCGs and our little mickey-mouse fix, but we beat that one to death. It worked all right.

WEITZ Helmet: I'm glad I wore my helmet protector during launch, because I sure banged around during that SEVA. My helmet was as clear as crystal when I needed it on EVA day.

WEITZ (CONT'D) equalize, you can then open that hatch and then open the OWS hatch equalization valve. Then you can be moving around in total forward volume rather than be waiting in the airlock.

CONRAD Suit drying - there was no moisture; much less than expected. We didn't get to the kind of workloads where we were sweating up the suits. The suit drying worked well and the suits were clean as a whistle. They didn't smell bad.

Ref. 1.42

KERWIN That was true throughout the mission everywhere. We didn't have areas of condensation on the walls so our clothes didn't get wet, at least not in the workshop or in the MDA.

CONRAD I think we were well aware of the fact that it was going to take us longer than the guys figured on the ground to manufacture the equipment in flight because we were in zero g. That's true in all the little extra things that we did, not only the SAS-deploy EVA where we made all that equipment but also in sewing together the panel to put outside. I spent about an hour and a half putting that panel together. You have to get good scissors, which were up in the EREP can in the MDA. You have to bring them back down, lay the stuff out, and restrain it. We were well aware that it was going to take us longer. And knowing that allowed us to get things done on time. We spent a good 6 to 7 man-hours putting together the SAS-deploy stuff.

KERWIN Because we had to do it all our own way. We put stanchions 5 feet apart to measure our rope out and then we strung the rope along the 25-foot pole. We cut it off so it fit exactly. We worried the problems of tangles and things, and we deployed it a couple of times.

CONRAD We were very careful about laying the lines out, and it took a long time to cut the gray tape and tape the lines to the original pole so that when it flaked out it came out straight, and all that just takes time.

KERWIN We figured how to tape things to your suit and where to tape
Ref. 1.43 it to your suit so you can reach them in a pressurized glove. And we just worked all that out in real time.

A-19

WEITZ The whole message is to let them work it out on the ground and then allow about twice that time in flight for the guys to do it, if you come up with an off-nominal, new situation.

CONRAD Of course, we made some refinements that were obvious to us that the ground really just left up to us. What they'd given us was adequate to do the job. There were a few places we did make refinements on that gear. We used different equipment. Instead of using that safety wire for tether hooks we got spring steel out of launch restraint stuff, but it bent up rings. We just took a little bit more time to do the job right.

WEITZ (CONT'D) I got with the TV camera. It was not so difficult. There is really more room in there than I thought, even from going to mockup and trying it.

CONRAD The flight equipment in the crew compartment configuration. The beds worked great. Everybody had enough room for their gear. There was enough Velcro around. We would set the duty timer up for the alarm clock, and I'd Velcro mine at the dosimeter place. It would stick right on there. I know you had a lot of gear laid out in your room. Everybody fixed up their sleep compartment the way they wanted them. We had adequate places to hold the clothes.
Ref. 1.44

KERWIN The thing I had about the sleep compartments, aside from thermal, which is completely off-nominal, is that it would not have worked at all to have had a staggered sleep cycle, because you were aware, in your sleep compartment, of any noise, any movement, any light that anybody made in the experiment compartment, the wardroom, the head, or the forward compartment.

WEITZ You didn't have your light barrier up.

CONRAD I think everybody that has seen the TV with voice on it has the impression that the vehicle was extremely noisy, because the noise is somewhere on the comm. The whole workshop is so quiet

KERWIN I'm a believer in the comfort box now. If the wall temperature is warm you begin to get uncomfortable about 75 or 80 degrees; if the wall temperature is cold, you could probably live with air temperatures of 85 degrees.

WEITZ It made more difference than I thought it would to use a little portable fan to blow warm workshop air in over the workshop heat exchangers.

KERWIN I thought the MDA was too cold for comfort most of the time.

WEITZ It was quite comfortable when we had enough power to turn the MDA wall heaters on and until the vehicle temperatures started coming up to the point to where they thought they had to turn them off. Below 65 degrees in the MDA was cold. You radiated body heat to the cold walls.

A-20

KERWIN I'd go to my sleep compartment and get my jacket when I was going up to the ATM.

Ref. 1.45

CONRAD Let me go back to one thing on the triangle shoes. I noticed on both feet there were ways I could put a load on those triangle shoes that made them come out of the grid work without unlocking them. I think you will see in the M151 movies where I will stop and turn the triangle up and reset the lock because I could pull my feet out of those triangles without unlocking the shoes. I never did figure why.

CONRAD (CONT) the 90, that also would do the same thing to my head. It would make it logically rest on the pillow, and I never used the overhead thing to hold my head on there. This is strictly an individual thing.

KERWIN I used it sometimes and sometimes I didn't. I thought that if I had to redesign it, I would make it even lighter and even more elastic at the bottom, so that it was a very gentle restraint. I would have put one more elastic band in the middle. Those were of a nice elasticity. You could tighten them or loosen them just the way you wanted them.

A-21

WEITZ All in all, I thought the sleep restraint was excellent.

CONRAD Well, let me comment on one other phenomenon. I don't know if the other guys noticed it or not. I slept most of the time with just the net, until we got down to the 72-degree area for about 3 nights, and then I slept with a blanket partially up. But you have no convection. And the net would trap the air around your feet. I noticed this especially in the lower extremities. And then your body would heat that air up. And even though you didn't have a blanket over you, because there is no convection, you had this warm air ball around your legs. It was really weird. If you got hot, all you did was stir your legs, which would move the air out of

Ref. 1.46

CONRAD (CONT'D) there, and then you'd reheat new air. But the air doesn't move. It doesn't circulate if it's not in the path of some blower air that's going through there. We had different thoughts about arranging the little duct in the bottom, which blew air up past your bed. I had mine off the wall, because if it blew it on my feet, I got too cold. But I could very definitely tell there was no convection there.

WEITZ I'm a little more warmblooded than you. For about 3 days there, I used the outer blanket, but only about up to the knees, just enough to keep my lower legs and feet warm. I never got under the net, because it was uncomfortable. I got too warm. Halfway through, I modified it with the scissors by cutting the net off and throwing it away. There was only a 3 day period that I anything. I just slept with my shorts and a pair of socks on. That net is really warm.

CONRAD The Swiss Army knife was very handy. It would float out of the knife pocket, unless it was restrained. I never restrained mine; I carried it in a zipper pocket. You guys keep it in a knife pocket with a tether ring restraint on it.

KERWIN I cut a little hole in my pants to slip the big ring through and clipped the knife on. I thought the clothing was real good.

WEITZ I'm glad I had the box pockets. I like those. They give you a lot of room. You don't need as big a waist as we had because they're is no gravity to pull your gut down, and your waist tends to shrink in.

CONRAD If I had it to do over again I would ask for a clean pair of socks every day. I had 12 pair of socks and your feet tend to sweat. On the second day of wearing a pair of socks, they were clammy. The gold T-shirt material is not very absorbent.

KERWIN I wound up having to ration socks and shorts and I wound up with extra T-shirts. It was a bit too warm to wear both the T-shirt and the soft shirt.

CONRAD That's right, we operated with the T-shirt or the gold T-shirt, but never both.

A-22

KERWIN Two coats were plenty. With four pairs of trousers I wound up not using one at all.

CONRAD The vehicle was extra clean. Working with any equipment, our hands really didn't get dirty. There was very little dust in the vehicle and there was nothing to get your hands dirty. We would wash our hands with soap, wipe them off on a towel, and see no dirt. We really did stay quite clean, and the clothes stayed clean. As Joe says, two coats and four pairs of pants

Ref. 1.46

CONRAD (CONT'D) for 28 days was adequate. The only thing I would like to add was more socks and maybe a few more shorts.

WEITZ I had a change of shorts for every other day, which was good enough for me.

CONRAD When we changed our shorts, we kept the used ones to exercise in. Those sweaty shorts we would throw away. We got 2 days of normal wear out of them, then we would wear them for 2 days for exercise. We put the fresh ones on for working. That worked very well.

WEITZ In moving around the vehicle and stabilizing yourself you use your toes a lot. You drag your feet over the grid, you stick your toes down in the grid, you hook your toes under things. We mentioned it, we have some pictures of it, we wore out the toes on both shoes, both the triangle shoes (the ankle-high shoes) and the gold boots.

KERWIN I wound up not using my slippers at all. I used my triangle shoes from morning until night. I would change from the triangles for the bicycle to the little mushrooms for general moving around and working. My general comment is that it serves as a restraint system. Wherever you stop to do a job, you want your feet restrained. I'm awfully glad we had the triangle shoes and the triangle grid all over the floor.

Ref. 1.46

WEITZ Yes, the triangle shoes were extremely useful.

KERWIN The side restraints worked out better than I thought they would.

WEITZ I used them all the time. I never used the foot restraints. In M487 we debriefed the over-the-top straps which were the same as the ones in the waste management compartment, essentially unusable, because they are too stiff, unadjustable, and have a preset. They have been folded over in the same place for a year. I didn't use the triangle because I didn't wear my triangle shoes very much.

KERWIN We hardly used the portable handholds almost anything serves as a handhold when you're arriving at a location. Foot restraints are needed at the work stations.

Thermal control - We didn't have any thermal control, we just lived with what we had. I thought I was most comfortable when the temperature was lowest. The 70- to 75-degree region was reasonable.

WEITZ When we started getting up to 77 to 78 degrees, we could really tell the difference. I think that's because I am sensitive to radiant heat. I could just feel the heat coming off the OWS circuit breaker panel and through the walls.

KERWIN Let me mention one thing that happened to me three times on the bicycle. I would change my mushrooms to my triangles to go ride the bike. If you don't cinch the wingnut down good and tight in those triangles, I found that they came loose while I was pumping the bike. Once the thing is loose there is no way to unlock it. You move your foot and thing doesn't unlock. I would up having to take my foot out of the boot, get off the bike, finishing unscrewing the shoe from the triangle and go get a screwdriver from the tool kit and wedge the thing until it unlocked it.

WEITZ I found the only way you could satisfactorily tie the triangle down is with a pair of pliers. You couldn't do it tight enough with your fingers.

We used most of the tools.

CONRAD We used just about every tool in the tool box.

WEITZ We are sure glad we had that extra set in the MDA. One ratchet fell part on us, and that ratchet is a valuable tool to have. We have a backup in that one torque wrench. It is bigger and more clumsy.

CONRAD Joe used the tool caddy for activation but I never needed it.

Ref. 1.47

I used my baggy pants pockets to carry the tools.

Visit days 5, 6, and 7 were learning days. The crewmen were feeling their way around the Workshop, finalizing the configuration, becoming organized, and adjusting to moving about the vehicle to perform the various tasks. Visit day 8 was a welcomed first day off. Starting with visit day 9, things were well organized and the crew thereafter performed normally, making fewer mistakes, and having plenty of time to perform the scheduled work.

Temperatures were acceptable after the parasol deployment, although the crew quarters tended to be a bit warm and the Multiple Docking Adapter was too cold. Crewmen generally wore jackets for Apollo Telescope Mount operations. The Scientist Pilot's sleep was affected late in the visit, due to the high temprerature of the wall in his sleep compartment.

Ref. 1.49

For the balance of the visit, the effects of weightlessness on the physical well-being of the crew can be quickly catalogued. Movement and working were easily accomplished - almost too easily. Sedentary occupations such as Apollo Telescope Mount operation were very undemanding physically, and one tended to want to move about or change position to avoid a sleepy or sluggish feeling. Remaining awake during the resting parts of the medical experiments was difficult. Physical examination disclosed that muscles which were not in active use were extremely soft, almost flaccid. One assumes a characteristic posture and even the facial expression changes in weightlessness, based on the relaxation of muscles which normally have a gravitational load. It was surprising that appetites held up as well as they did. A day without physical activity was conducive to boredom and restlessness, and daily exercise became mandatory and felt very good. Sleeping was a bit more difficult and less sleep appeared to be needed - probably only 5 to 6 hours of actual sleep would have been sufficient.

The success of the systems designed for personal hygiene, eating, and sleeping was most important in maintaining crew well-being. Activities such as shaving, washing, and brushing teeth were relatively routine and even the zero-g shower, while cumbersome to clean up afterwards, was a welcome and refreshing break in the routine. The sleep compartment was comfortable and there was sufficient room for equipment stowage. Figure 10-8 shows the Commander in the sleeping quarters. Staggered sleep cycles would have been disruptive because the Workshop is quiet and any noise or light induced by movement by an awakening crewman would disturb the sleeping crewmen. When all of the lights are off and the windows are covered, the vehicle is very dark and care must be exercised in moving around in the Workshop. There is no sensation of motion and it is therefore extremely easy to bump into things and to become disoriented.

WEITZ No.

SPEAKER As far as operating M509?

CONRAD We discussed that and concluded that it wouldn't be.

SPEAKER Are there any items aboard Skylab which support the general habitability spectrum that you would consider to need mandatory changes for follow-on missions?

WEITZ That's an awful broad question. What kind of missions?

SPEAKER The other two Skylab missions.

SPEAKER I guess that could be turned around to say, were there any acute habitability problems? I haven't seen any.

A-25

WEITZ The thing that comes first to mind are the things like the foot restraints in the head. Now do you want to consider that mandatory?

CONRAD Well, the general comments that we had on habitability were we all had the feeling we wanted more socks and skivvies. I believe they're going to take care of that and use some of those items for stowing around other equipment that's going up and packing.

SPEAKER You commented on the absence of a long-sleeved shirt, too, several times.

CONRAD That's entirely dependent on what you do with the next thermal shield. When we were at the low Betas and we were running MDA heaters, it was quite comfortable throughout the vehicle. It was only when the temperature was going up in the workshop, and the heaters were off in the MDA, and we had a rather marked change in temperature and running very low temperature, 62 or something like that up in the MDA, a guy tended to get a little cold soaked up there sitting at the ATM panel.

WEITZ I got hit with that before. Apparently you made that comment - -

CONRAD Yes.

WEITZ - - and that's not mine. I found a jacket completely adequate. And I would not have wanted a long-sleeved shirt.

KERWIN If I was marginally cold, I would have put a T-shirt on or another soft shirt on and solved it that way. Hot sleeping quarters were my complaint near the end of the mission. I'd like to see it solved by whatever rearrangements they make to the mail. If not, you

Ref. 1.50

KERWIN (CONT'D) could always move out and find yourself a cooler place to sleep. So, you know, that's not a mandatory constraint, either.

Ref. 1.50

KERWIN We would like to see the follow-on crews have more opportunities to substitute food items, if there was one or two that they became particularly reluctant to eat. We've made that input. I think that is a highly desirable input. I don't know whether it's mandatory or not. You can grit your teeth and survive.

SPEAKER Do you have any feeling why you made the comment that the spicier foods, or taste, I guess you'd say, did not quite taste as well in 5 psi or zero g, or whatever the situation is. Some how you've given me the impression that things lost their taste.

A-26

CONRAD That's the impression that we have.

KERWIN That's not the first time I've heard that comment. It's the first time I've made it, but I think that if we dug deep enough in some of the Gemini or early Apollo debriefings, we would find that comment again, because it has a familiar sound to it. We're disagreed as to why it happens.

CONRAD (CONT'D) simple thing when I was locked in, and then unlock again to go someplace else. There were occasions where I had a simpler way of restraining myself. Those shoes were pretty simple. You know, I would have done it because it almost got to be a tradeoff; the amount of time was the same. It took me longer to do it unrestrained, but I had the satisfaction of not having to go through the exercise of restraining and unrestraining myself.

SPEAKER **You mentioned that you and Paul changed shoes several times a day. The shoes were laced. I suppose, if nothing else, we could have a slicker way of changing shoes.**

CONRAD **We discussed that a little bit. When you put a load on those triangle shoes, I was happy that I had high laced-up triangle shoes. I don't think that I would have liked the zipper arrangement to get into those shoes because I had the feeling that the zipper would bother me, but I don't know that that's true.**

WEITZ **Lacing and unlacing those shoes bugged me.**

CONRAD **Yes. It was a pain in the neck, but when I wanted to have that kind of support, I was glad I had it.**

A-27

Ref. 1.52

KERWIN An easier way would be appreciated, but I made an input earlier that we didn't want zippers, I think, because I was worried about the fit, and also failure modes. It seemed to me, a lace is an easy and accustomed thing. Could we have shoes in the future like boots where the laces are very few, all you've got is a couple of laces to thread and tie and you're there.

SPEAKER **Eight laces.**

WEITZ Or hooks that stick into eyelets on the high weather boots.

KERWIN I don't know if I ever mentioned it, but I failed one of my triangle shoes. I literally tore the metal on one occasion.

SPEAKER **Under the instep?**

KERWIN **About an inch from the toe. Yes.**

WEITZ You said repeatedly that you didn't have any particular difficulty in handling objects and moving masses about. Did you ever psych out anything that you thought approached a series of thresholds like a family of curves in terms

SPEAKER Pete, did you ever have to use your thermal gloves in

Ref. 1.53 operating?

CONRAD Yes, sir. On those rods, you sure do or you are going to leave skin on them. They're cold.

WEITZ But those gloves are quite adequate.

SPEAKER You noticed no damage when you were installing S149?

WEITZ That's right, but neither did I look especially hard for any.

SPEAKER Any problem on fastening the rods with each other when they were cold like that?

A-28

WEITZ No.

CONRAD No. I think that you pick up moisture on the thread. It's a little harder to screw the rods back on now than it was from the very first time when it was super clean and never had any moisture on it. I don't know whether they had any dry lube on them, but that's just a subjective comment.

SPEAKER When you put the head off, did you have a chance to look at the sunshields, either on the outside or inside? If

SPEAKER: OK, crew provision area

SPEAKER: What was the nature of the soft boot damage?

CDR: Soft boot?

PLT: Yeah, the gold

CDR: The gold boots

PLT: There is apparently a teflon sole inside that forms the sole of the shoe, right? It looked like a piece of teflon about 1/8 of an inch thick and we just--over which is sewed this gold PBI or whatever it is, and it just wore through.

CDR: In the toe area?

PLT: Around the toe, yes.

SPEAKER: What that teflon is, it gives you a toe cap to give you some body down there in the end of it. It was put in there during----. The gold area did wear off and it wore a hole in the toe area and not back up around the instep area.

PLT: Yeah, yeah.

CDR: You call that junction, you know, that's the last, right. You got a sole and onto the sole you have sewn the body of the shoe.

SPEAKER: Right

CDR: OK, everybody kept shoving their toes into the triangle floor when we were wearing those things to gain footholds. It's abraiding that general area area around the last and around that sole.

PLT: Didn't we wear them back?

CDR: We wore them back, yeah, you ought to have those up.

PLT: You ought to look at them.

CDR: The last time we saw the clothes they were locked in the command module and--no--yes, and the boots are in them. They are--the boots are in them, the way we taped them up. To stop them from wearing after we realized they were wearing. We taped them up with gray tape. There's an awful lot of photographs around. I think you can find that will show those.

SPEAKER: In the ODAE, how many batteries--

CDR: Wait, let's go to the other shoes, right?

SPEAKER: Well, were all done talking about them.

CDR: You all satisfied with the damage to the other shoes? You got the photographs of where they wore out in the heels? and when they wore out in the toes?

SPEAKER: The triangle shoes you're talking about?

CDR: Yes

Ref. 1.54

So there's one a drift in the vehicle some place and there's eleven stowed and they're all good.

SPEAKER: They're all functional?

CDR: They're all good.

SPEAKER: Was Joe the only crewman to pressurize the hypertensive garment? Was the decay in the first 15 minutes or was it continuous?

SPT: It was continuous. I believe I was the only one to pressurize it, other than as a test. That is, briefly. I know, Pete, briefly pumped his up just to see if it would hold pressure, and immediately pumped it down again. Didn't get a decay check.

CDR: That was in flight?

SPT: Mine was a slow, continuous decay.

SPEAKER: Last question. What was considered the most unused item of clothing?

SPT: The most unused?

PLT: The bump hat.

CDR: None. I used--everybody used everything. We used the ration.

SPT: Only thing I didn't use were the gloves. I never used the gloves.

SPEAKER. Yeah, Joe made some comments on some of the tapes there that he didn't use the gloves. We were wondering if there was any other article of clothing that you really didn't find a need for.

SPT: No, I think the reason that I didn't use the gloves was I never operated much at the scientific airlock. I never had hot or cold stuff to handle. They were good for that. Pete and Paul used them for that and I wouldn't eliminate them.

CDR: We used them both for heat protection when we went down there in the very beginning and everything was pretty damn hot down there and we had to use them on seven rail--seven rod retract on S-073.

SPEAKER: Just got one more question.

PLT: Well, besides the clothing module, now there may be some lockers in there, right? Besides the crewmen's clothing module, what other articles of clothing are included in that question?

SPEAKER: We had reference only to that 28 day clothing module?

PLT: OK fine. We used everything.

CDR: Let me tell you what we did with some of them. We had different options on the underwear. But we had the feeling that we, one would have liked to have had more underwear

Ref. 1.55

and would have liked to have had more socks. Now, I had some different combinations like they had long ones, and I cut them off at the knees to make them like the knee-length ones and used them that way. You know, so I, we all used everything that was in there. We, matter of fact, the one thing that I hadn't seen which was a great help to me was the inventory card. I'd never seen the inventory card before, and I used the inventory card to manage the clothes through 28 days.

SPEAKER: We have another question pertaining to clothing trying to get a handle on configuration of T-shirts, PBI shirts and so forth. Sometimes you had only the T-shirt, sometimes both, and sometimes perhaps, the PBI alone. Could you guess at what temperature you found it necessary to get rid of the PBI shirt and have the T-shirt only?

CDR: Oh

PLT: That's going to vary from individual to individual, I'm sure mine is lower than Pete's.

SPT: Somewhere above 75 degrees.

SPEAKER: Above 75?

SPT: I would feel more comfortable with just a T-shirt. Ideally, if you were running 68 or 70 degrees, you would probably

wear them both. You would wear the T-shirt to absorb perspiration and the PBI shirt over that.

PLT: That's right, from a strictly--

SPT: But it was too hot a lot of times to do that.

SPEAKER: When you made the decision to wear the T-shirt only, a-parently there's a comment that the PBI shirt only is uncomfortable. Could you expand on that a little bit? What is uncomfortable about it? Does it--

Ref 1.55

CDR: It doesn't absorb moisture.

SPEAKER: It's a temperature thing then rather than an irritation or a--

SPT: You know how clammy those artificial fabrics can be if you sweat under them. It was that.

CDR: I used a different scheme. I normally slept in my T-shirt and used that as something to sleep in and, normally, except when it got very hot, I always wore the PBI alone during the day. I cycled that way, I'd wear the PBI during the day and a cotten T-shirt in the sleeping bag at night.

SPEAKER: When you were wearing the PBI by itself, you found that unacceptable?

CDR: When I got hot, it gets clammy.

SPT: I wore it by itself a lot and--here's the problem as I saw it. It was OK, it wasn't as comfortable as the T-shirt, and also when you were wearing it just over your skin it would get dirty quicker and get smelly.

PLT: Stink

SPT: And the original (laughter). That's not a medical term, Paul. (laughter)

PLT: But it's one that even you can understand, right? (laughter)

SPT: The original plan was to make the PBI shirts go four days by wearing a T-shirt under them.

SPEAKER: Unh hunh

SPT: But that was pretty warm most of the time. So, you'd wear the PBI shirt a couple of days and it would get stinky and then I'd wear the T-shirt for a day or two.

SPEAKER: Well, of course it's based on the issue that's before us now, you know, if you are going to wear the T-shirt alone, it doesn't meet the flammability requirements and there is an issue of what are we going to do about that. We're trying--

SPT: Could you dye it brown so that you wouldn't know the difference. (laughter)

SPEAKER: Quit taking pictures, you know, it's easier that way.

Ref. 1.55

CDR: Don't worry, we commented that we were going to get static on that when we got back.

SPT: Yeah, and the other business was for exercise and/or M-171 on the bike. The brown pants and the PBI shirt were just too damn warm on that as you saw, we all wound up riding the bike in our underwear. And taking our chances. And I guess for the period of time that's involved there, that's acceptable, in my opinion.

SPEAKER: OK, that's all I have.

SPEAKER: Hey, let me ask another question. At one time I remember some comment about the T-shirts, the possibility of needing a long sleeved T-shirt.

CDR: OK, that's me. I run cold all the time. When I was operating up in the MDA for four passes on the ATM, I'd get pretty cold up there but it runs about 62 or 63 up there with the heaters off. You're just sitting at that panel, completely powered down. I'd get pretty cold, so that was an individual comment. I would have liked to have had a long sleeved shirt like T-shirt or cotton only because that's the stuff that stays close to your skin, you know. You wear that jacket and it's got the cuffs in it but in zero-g everything tends to float out. My arms used to get a little cold sitting up there, there were occasions I'd get cold enough up there where I

wore the gloves to keep my hands warm. But that's an individual thing again. That's another reason I preferred the three-quarter length cotton underdrawers. If I had to do over again, and I was kind of test hopping those boxer shorts. I didn't really think I was going to like them. I didn't like them, because, I wore them but I didn't like them because they bulge out all the time. I like the knee-length cotton underwear. If I were going to do it over again that's all I'd put in there for underdrawers.

PLT: I got a question. What do you guys pack those clothing modules with, the same ram you pack the main chutes with? (laughter)

PLT: Man. I pulled that first pile of stuff out ----

CDR: Pulling the first one out with a lot with it, you'd never get it back in again. You gotta get to about day 14 before you can handle anything in there.

SPEAKER: Was that a real problem?

PLT: No, except like Pete said--I tried to pull one set of skivvies out and got the whole section out. I wound up with clothes in two lockers for about half--fourteen days.

CDR: Either that, or if you pull a pair of socks out they grow to about size 98 (laughter) as you're pulling them out and holding everything else in.

Ref. 1.55

SPEAKER: OK. Thank you very much. That's it.

SPEAKER: Will you have a comment on the suit donning and doffing difficulties. Is it better to have a donning station, or is it better to try to put them on in the airlock, or better to use the buddy system, or--

CDR: I think what we had was adequate, and my suggestion is you look at the movies. They'll answer all the questions better than we can.

PLT: Yeah. Foot restraints with a buddy to help you is what it boils down to.

CDR: They worked out fine.

PLT: Yeah, I don't think you need other hand holds around, or anything else.

CDR: The buddy does not need foot restraints. You know how we used to do it in one-g and figure we'd have to put the foot restraints facing each other and work that way. It turned out that the guy that's putting the suit on locks his feet with those pins in the foot restraint and the other guy just free floats and stuffs him in there. I think the movies will answer all your questions.

SPEAKER: OK, fine and dandy, let's go on to the guidance, now.

SPEAKER: Were tool kits and spares conveniently located?

PLT: That's another chicken and egg kind of question.

CDR: It's so easy to get around the vehicle that if you happen to be at the opposite end and you want to go down and get a tool it was always fun to do three 360's on the way and you were down and back.

SPEAKER: Were tool tethers needed on any of the IVA tasks that you saw? Do you feel that they would have been handy?

Ref. 1.56

PLT: No, I think I wouldn't have used them. I wound up sticking them in my pocket anyway.

SPEAKER: We noticed that you didn't use the tool caddy much. apparently, from what we've read on the . . .

A-34

PLT: I used it. You didn't use yours at all did you? And Joe and I used it on the first activation day, which would have been mission day three, I guess.

CDR: Yeah. Let me say something about the tool caddy. We overkilled the tool caddy principle in trying to design it for zero-g, and I have the feeling that the reason I didn't use it is because I didn't like it down on the ground. If you look at the telephone pole lineman's leather belt that he essentially just friction slides his wrenches and pliers and things in which you can buy in a store. That

would have worked super up there if you didn't to carry a bunch of tools around with you. But it turned out that most tasks required very few tools. I just found that I was going to do a task that required 4 or 5 pieces of tools, the pockets on my pants were more than adequate. I put them in there and away I'd go and do it.

Ref. 1.57

SPEAKER: You had no problems getting to the tools or . . .

CDR: Well, I really felt it was easier opening the zipper on the one pocket, than it was trying to sort through the rubber, you know, the whole thing and . . . I mean, I think everybody tried to do the best job they could on the tool caddy, but it really didn't come out the way I envisioned it. What I still envision, if you wanted to use a device like that, is that kind of leather belt that just has the slide pockets and they are friction hold.

CDR: You think that would have worked?

PLT: I don't think you need it.

CDR: Yeah, I don't think you need it either, unless again, you're considering future design where you got more maintenance tasks that are more complicated. A guy is going to have to carry more tools around with him.

SPEAKER: In which case, you might want to have just a kit that you carry.

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

212 20 07 41	CC	Skylab, Houston. We've got you stateside for 14 minutes.
	CDR	Got a few questions for you. First, where are the utility gloves? Second, we were supposed to transfer two drug cans to 706, but 706 is completely full. We stuck it in 732 temporarily, waiting your recommendation. And we need to know where the utility power cables are stowed.
Ref. 2.1		
	CC	Okay, we'll be right with you.
	SPT	And one more. Those power cables I'm going to use on page 2-5 of the Student Project Checklist to hook up the light to the ED52 experiment. Similarly, on the preceding page 2-4 it calls for the photography of that experiment. And apparently we've not received any pads for the use of the DAC and you could - you might run down that for me so that I could complete something else by ED52.
	CC	Okay, Owen.
212 20 09 09	SPT	And one more while we're on the subject of not enough things that we can find. I don't have the Biomed Checklist out with me right now, but when I finished calibrations of the BMMD M172 yesterday, the clips and springs were to be taken off and stowed at a location which apparently has no label and is no locker. I suspect it's a location on the floor or something like that, and my question is where do these springs and clips go that were used for M172 calibration?
	CC	Okay.
212 20 10 58	SPT	Boy, it's an amazing view of the San Francisco Bay area. It's - looking out the window while I came over to talk to you here, Dick - perfectly clear. You can see the whole breadth of the place.
	CC	Okay.

	CC	Yes, we're still working now. We've got about 30 seconds to LOS. We will see you over Vanguard in 10 minutes and we should have the answers then.
	PLT	Thank you.
	CC	And as we go over the hill, leave the drug cans in 732, that's fine for now.
	SPT	Okay.
212 20 32 22	CC	Skylab, Houston, through Vanguard. We've got you for 9 minutes.
	CC	And no need to acknowledge. The utility gloves are located in your clothing module. The utility power cables, of which there are a total of eight, may be found in D-435, D-440, or possibly in use at D-407; that's above the ring lockers.
Ref. 2.2		
212 20 33 03	PLT	Okay, thank you, Story. We got this S149 retracted, and we got the SAL door closed, but we can't get the rod pulled through the panel all the way so that we could get the latch - latch to mate. We think maybe it's just cold and we're going to let it warm up for awhile so we could pull in a little further. It lacks about an inch of - of coming in far enough. And we noticed as we were pulling that in that it really wanted to go off by itself. You really got to hold on to that thing and make sure you get the door closed.
	CC	Okay, copy that.
	CC	Jack, we need some clarification on your S149 operation.
212 20 35 20	PLT	Okay, Story. I was working uh the checklist for S149 retract. And one little interesting thing we noted was that it suddenly started pulling around and wanted to go off by itself very readily. If we - if there hadn't been somebody on the end of it it would have gone right on out. So we're going to be very careful of that. That's just a note. Okay, now - we can't get the rod - the last rod - rod A, pulled back far enough so that when

automatic trigger the way it's suppose to. I haven't heard anything about it since then, but as a minimum, of course, we could go ahead and release those spiders into the cage and then take still photographs of any activity that might be produced, if they spin a web - if she spins a web. And I'm wondering if you've had any thoughts about that in the last 48 hours or so.

CC — Okay, I'll see if we can get some words to you on that, Owen. Also - -

SPT — And I suspect we don't want to leave it in the vial too long.

CC — Right. You are absolutely correct. Regarding your comment earlier on the unable [sic] to get displays except on BUS 2 off the ATM C&D, I guess we would like you to check the circuit breakers for the inverter lighting control assembly number 1 and AC-1 on the ATM C&D at your convenience.

214 23 29 52 SPT — Now that you mention it, I believe number 1 is open; I'll go check it, yes.

214 23 30 24 CC — Okay. And, CDR, when you get a chance, if you could give us an update on the condensate holding tank dump, we would appreciate it.

214 23 30 45 CDR — Roger, Crip. The dump's complete. I am now putting a vacuum on the tank.

CC — Okay, we copy that.

Ref. 2.3

CDR — Crip, we just had our dinner, and I'm getting ready to start working on S073. And the other day, we started talking about the fact that the utility gloves were in our clothing module. I just spent about 10 minutes completely taking everything out of my clothing module, and I can't find any utility gloves in there, although, I agree with you; they are suppose to be in there. Wonder where they might be.

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

215 00 00 02 CC — We copy what you say and understand it's inop. I've got an answer for you on that ED52. We sent up a general message - a permanent general message earlier today. It was permanent general message number 2, which dealt with the procedure for ED52. And our intent was for you to run that as a shopping list item. Do you know the message I'm talking about?

SPT — No, I'm afraid I don't, Bob. I'll go look it up, though.

CC — Okay. It was permanent general message number 2 and the message number on it was 0635, if that'll help. And if there's a problem with it - if it's lost or anything, well, we can always retransmit it. And - -

SPT — Roger. I'll check it. Thank you.

CC — Okeydoke. And if somebody could turn off EXPERIMENT 1 and 2 TAPE RECORDERS for us we would appreciate it.

215 00 00 51 SPT — I'll go do it.

Ref. 2.4

CC — Also, for the CDR. I've got a question on his gloves. And we were all fouled up.

SPT — Stand by.

CDR — Go ahead.

CC — Okay. Al, all of the gloves are in D-416. They are in a contingency clothing module up there.

CDR — D-416. I'll go find them. Thanks.

CC — Yes sir.

CC — Also, you gentlemen, I think, had a question earlier regarding the M131 tally cards as to whether you could erase them or not. We would prefer for you to not. We've had a - somewhat of a data

	CC	Okay, I'll see - see - if I can get you an answer for that one.
215 01 45 36	CDR	We're just - we're wondering if it ever came up for sure. We can't find it anyhow.
	CC	Fairly certain it was on board. We'll - we'll try to get you a specific answer on that.
	CDR	I wouldn't be surprised if there are three of four items that are stashed somewhere right now where we can't exactly put our fingers on them, of all the hundreds we moved in here.
	CC	Yes, that's a pretty big place to keep track of it all. We're about 1 minute from - -
Ref. 2.5	CDR	Yes, I'm going to open a clothing store when I leave the program. We've got enough clothes up here to run one, I'll tell you.
215 01 46 08	CC	Sounds like it. We're about 45 seconds from LOS now, AL. And, next pass is at Ascension - Ascension at 01:50. And we'll be doing a data recorder dump at Ascension and also that'll be your med - medical conference.
A-37	CDR	Okay. By the way, I tried everything that you mentioned on S073. Every single thing, none of it was workable. I put it - I put in the shorting plug and put it into DECREASE and that's where it sets right now.
	CC	Roger.
215 01 46 39	CDR	I banged it a lot on the sides. Could change the trunnion, but never the shaft.
215 01 46 43	CC	Okeydoke. That timer was in A-9, by the way. And the next pass is going to be, after Ascension, is Guam at 02:35, and I've got some news for you there if you'd like it.
	CDR	Sounds good. I'm not sure we won't be - Okay. We'll be waiting to hear from you. What's our wake-up time tomorrow morning?

	CDR	Story, we were checking our Flight Plan trying to understand something. We knew that the day off that we gave up was going to be Friday, which is today, but we looked at our Flight Plan, preflight, and it was going to be tomorrow. What - what's now the plan?
	CC	Stand by 1.
	SPT	And the teleprinter paper is changed. You might give it a try and make sure she's all working right from the ground.
Ref. 2.8	CC	Okay, I copy that, Owen. And did you all find the S054 timer that was wrapped up in a sock in A-9?
	CDR	Not yet.
	CC	Okay.
215 13 07 03	CC	CDR, Houston.
	CDR	Go ahead.
	CC	Okay. At present, we got a standard on-orbit day for you, including probably an EREP pass, an M092/171, a 131, and a couple corollaries.
	CDR	That's tomorrow?
	CC	Yes, sir. And also about four ATM orbits.
	CDR	Okay, that's good. Just trying to get our things straightened out up here in our minds so we know where we are and what we're doing. Good.
	CC	Okay.
	CC	And Skylab, no need to reply, but we're looking at day 10 or 11 for your EVA, and we're fluctuating between those two because of a potential EREP pass over the United States and Africa on day 10.
	CDR	That's great, we'll be ready.
	CC	Okay.

222 02 27 14 CDR — Okay. Let's talk a little bit about the lighting. It seems to me that the light is dim but adequate, except for a few times. One, when you want to do closeup work like repair an item, and whenever that happens, then you usually have bright light everywhere, but you need some sort of good carry-around light that you can sit on your head. I think something like that so that you could - something like a miner's lamp - maybe not that bright - maybe that isn't the right name to use with it, but essentially a helmet-mounted light that you could go get if you wanted to do some fine work down in the dark holes where you can't afford a lot of light and waste the light. Secondly, we need bright light in certain areas. For example, we need it in the head. When you're shaving, you can't see your face. You've got a light bulb on the ceiling and you can't see the whiskers that are down on your neck. We need to get some - some rea - real bright lights for the head, for example. We need to get some bright lights any place that you're going to be looking in mirrors. And those two items, I think, would make the lighting seem much, much more useful. Also, if there's a place where you're going to do a lot of reading or writing, bright lights are - are really called for. The kind of lighting we have in here is probably just enough for the - ...

222 02 28 28 CDR — These lights are very safe. You have the feeling that you're not going to break them if ... flip out in the air. They're nice and soft. They're not hard to look at. Everything about them is good, except we just need a little more brilliance at some points.

222 02 28 45 PLT — Okay, that takes care of the lights. Like we said noise is not an objectionable factor, to me, at any rate. Temperature is - been running - What is it? Around 75 now? 70 to 75.

222 02 29 03 PLT — It depends on where you are and where the sensor's located. This one says 70 over my head here, so it's 70 to 75 in the spacecraft, which for me is quite comfortable. Al likes it a little cooler, and Owen likes it all right. I was fairly well

Ref. 2.12

satisfied the other day when - before we got the sail up when it was hitting around 75 to 80. It was a little warm, but it cooled off after we got the lights off and so forth. And it warmed up in the afternoon, and we circulated around in here with everything from full trousers and shirts to skivvies and - and seemed to feel quite comfortable temperature-wise in any of those clothes. Humidity-wise, it's fairly dry in here. Our noses are dry and - and do some bleeding still after 2 weeks in the mission. Lips are dry and are not really chapped, but on the verge of getting chapped. One nice thing is that it doesn't take you long to dry off after exercise. You don't sweat much and stink a lot. It doesn't smell like a locker room in here. Al is - -

CDR — ... stink like a locker room (laughter).

SPT — Let's hope it doesn't ...

222 02 30 40 PLT — (laughter) We have some disagreement on the smell. It doesn't smell like a locker room (laughter), but frequently like an outhouse (laughter). We haven't lost our sense of humor, anyway; but smells don't seem to persist too much in here for some reason since we've fairly decent airflow, which is the next subject. The airflow, I think, does help to maintain the - the - the comfortable atmosphere, and, of course, that's also what causes all the junk to collect on the screen ... centrifuge ... collector ... and that kind of thing.

SPT — And ... slightly. ... they are retained in a miserable sort of a container ...

222 02 32 31 SPT — I was just commenting that the silverware needs a better container. Something that will really hold them in. The ones we've got, they float out every time we open the door. Also something that you can clean and keep clean and have ready access to. That's a particularly bad-designed object.

222 02 32 46 PLT — Something else that we use a lot are these little spring bungees. We just stretch them across the lockers and stick everything behind them. So it looks like to me that if we make one of these things

Ref. 2.13

it's easier to stick stuff in your pocket and - or put in a bag. The caddy is just - is an open pocket. It doesn't seem to have any big advantage.

223 19 47 25 CDR

Portable fan, so-so. It doesn't have enough blowing force and I'd give it - by the way, let me back up. On sleep restraint, I'd give a very good, or adequate. Needs more work, but it's on the right track. Trash airlock, I'd have to give a poor. Vacuum cleaner, poor. Wardroom table (noneating uses), I'd have to give it poor to adequate. It has no restraints or any other things. You put the top on there and try to put a book down, you got to go get the bungees. Not enough Velcro. It just - doesn't make a good desk. And we do need something of that nature. Tool caddy, I'd give it a poor and not needed. Portable fan, I'd give poor to adequate - needed, but not used because it's too much trouble to have that blowing up there.

223 19 48 14 CDR

ODAE kit - that's a good thing, particularly the music. Everybody likes it. The only problem is we end up having to work on those rollers that drive the tapes all the time because they wear out. Suggest an improved tape drive, or if not, multiple spec - special rollers which you snap on. So when your roller quits working and driving, you took off the old, snap on a new one, and press on. Their cleaning and drying and fooling around with during working hours takes some time and is not useful. I won't go through each item except books are a good idea; playing cards are poor idea; darts are out to lunch. Exercisers probably ought to be there, but we've been - not been using them. I'll think about it some more.

A-39

223 19 49 09 CDR

Garments, garments are good. We got enough - sufficient garments. And they fit well; the only problem I can see with the garments is there's no convenient loops on them the size - the snaps that are the same size as the stuff on the wall, so that you can snap holders, strings to it, and carry things about.

Ref. 2.14

223 19 49 31 CDR

Small sized books fit well in the pocket. The large ones don't and you just try to attach it to the string and if that string doesn't really attach, it's not convenient anywhere. The concept of short - short sleeves and short-leg and long - long-legged pants is superb. It works great. We use them a lot, and should not be changed. Shirts are good; jackets are good, and it's cool enough to wear them. Clothes - clothes are one of the best. I think the only bad thing about the clothes are the pockets for the scissors, the pocket for the knife. We should have made a flap that held them down with Velcro about twice as big, so as to get some Velcro grip. We're always losing scissors and knives because they get banged out of our pockets as we go through hatches. Light baffle works well; no complaints. By the way, I give garments a very good. I give light baffle a [sic] excellent, I guess.

223 19 50 19 CDR

Privacy curtains, seems to work okay. Doesn't block completely the light and - nor the ... We need a place where everybody can go and close the door and the sound quits, noise quits, and he doesn't have any other problems after that. Play his music as loud as he wants, and nobody hears it. Privacy curtain does not do that. For that reason, I'd give it - a poor. This is the CDR. All that past information goes to 487 experimenters. 487-3A completed at this time, I think, 51 -

223 19 50 52 CDR

CDR out.

TIME SKIP

223 20 29 28 PLT

PLT on channel A for the ATM people. I notice that the prominence emanating from active region 85 which I've been noting for some time has, in the last few minutes, disappeared. Time now is 20:30. I would say it has disappeared in the last 5 to 10 minutes.

223 20 29 59 PLT

End of message.

223 20 33 14 PLT

Okay, space fans; this is Jack again on channel A for the ATM folks. Here's something you might want to incorporate in the simulator. I noticed on the last series of frames - pictures for S054, a exposure reading 256. That's the nifty little timer that we got, timed out about 10 seconds

223 23 13 28 PLT

Ref. 2.15

Triangular shoe cleats and grid. I gave them a very good; I think it's been a definite advantage to have grid in as many places as possible, because you never know where you need to stand or where you need to anchor yourself and you certainly can use the grid we've got to good advantage when ... and ... The triangle shoes, I wear - they - one on each foot all the time, except when I'm sleeping, of course. I found them very handy. I've noticed that they tend to - perhaps I have them too loose. That's the way I like them, but whatever position they are, they tend to come out of the grid in the locked position; frequently have to reach down and twist them around to line them up so they'll go in the next time.

223 23 14 26 PLT

But the triangle shoe cleats are great and I haven't used the conical shoe cleats at all. I haven't tried them. I might mention that one place you really need some handholds is right around the film vault. There's nothing there to hang on to. That film vault is just a big square object and you just can't grab on. You don't have any triangular shoes on and you're pretty much out of luck in that film-vault area. Frequently go up there with our socks on late at night and put cameras away early in the morning, before you get your triangle shoes on, and it's a real unhandy place to be without handholds or - or foot restraints.

223 23 15 13 PLT

Portable PGA foot restraints - correction - ATM foot platform is very good. I use it all the time when I'm at the ATM, but don't use the chair. And I always have myself anchored by one foot at the ATM.

223 23 15 31 PLT

Portable PGA foot restraints are - I tried forgetting this. I'd rate them excellent. The extra little pins that were put in there to keep the feet in there, the PGAs down there by themselves were a very good position. And the portable foot restraints worked very well in suiting up, and they also worked very well on the EVA the other day when we carried a set outdoors to put up the sail.

223 23 35 59 PLT

Wardroom tables for noneating uses, don't use them much for anything but eating. So the lid's always stowed up there in the top. Once in a while, we put the lid down on the food table - food trays, and do some checklist changes and stuff on them and you always have to hold things down. So if there's some kind of little spring or something over top of the - the some kind of checklist or paper retention device on top of the wardroom table, why it would be a plus; it's desirable, but not mandatory.

223 23 36 36 PLT

Ref. 2.16

Tool caddy, I haven't used it but once. Never usually get enough tools out at one time. When I got a lot of tools out, why I used it. But otherwise, I'm mostly sticking them in my pocket. The time I did use it, however, it went very well. Then once I didn't tie it around my waist so I just carried it in for the VTR changeout and stuck it underneath something and hooked the tools to it.

223 23 3700 PLT

Portable fans - portable fans; we got two of them. They work very good. One of them we got in the workshop air into the cooler MDA area. It runs all the time, night and day. Doesn't make any noise. Puts out a fairly good airflow, and - and doesn't seem to get hot. Those portable fans are made for long life. One other port - portable fan we use is the one we hook on the ceiling in the experiment compartment to point at the guy who's riding the bike to keep him cool. And it works very well for that purpose.

223 23 37 42 PLT

ODAE kit, I guess that must be -

CDR

Hey! Jack. ... entertainment kit.

PLT

Okay. The entertainment kit. The only thing that's got any use is the tapes. We have a busted tape recorder in the wardroom there. And we'd sure like it to be working. The other tape recorders, I don't give them a real good rating. The one I've got doesn't seem to play very well. The tone quality isn't real good. I think the tapes are better than the tape recorder is telling me. I clean it every once in a while; but it doesn't

seem to make a lot of difference. It turns out that I can't figure out how to use the earphones. When you plug the earphones in, it doesn't cut out the speakers, so you plug the earphones in and use them but it bothers everybody. Those are the - some of the funkiest earphones I've ever seen and I don't think they're much good. Although I guess they can be used. I tried it once, but I didn't think much of them. Must be a better kind of earphone than those. We haven't used the balls in the entertainment kit; we haven't used the cards. We haven't had a chance to read many books - any books at all. So we haven't used that; the darts we haven't used. The only thing we used out of the entertainment kit, I guess, is the tapes. And they are a real plus and a real good addition. We frequently listen to them when we're working at a place that our concentration permits us to listen to music. We carry the portable tape recorders around with us and although they don't have quite the quality I would like them to have, they are sure a heck of a lot better than nothing. And - and some of them are working better than others.

A-41

223 23 39 43 PLT

Ref. 2.17

Garments, I like the clothes okay. I normally don't wear a T-shirt except when I'm sleeping. I just throw - throw on the long-sleeve jacket over my bare skin and I like the trousers okay, too. My left trouser pocket that keeps the checklist in, this leg is ripped down the side so that it doesn't hold stuff very well but the pair I get next week may be better. You need a place to keep a flashlight in the trousers but there isn't one there. It's not required, but it would have been nice if we'd have had one put in there. Lose the scissors a lot. They seem to keep coming out all of the time, so I took them out of the scissors' pocket, put them in one of the other pockets. The scissors' pocket doesn't do the job for the scissors.

223 23 40 42 PLT

Underwear. Underwear is underwear. It works okay, works fine. I got some jockey shorts, some boxer shorts; I wear either one. And socks are fine, too. I haven't tried the gloves or any of that stuff yet.

CDR Sorry, I couldn't hear you.

CC You can turn the tape recorder off between your marks.

CDR Okay, good. Thank you.

Ref. 2.18

CC And on the TV down here, we're seeing everybody wearing jackets. Are you cold up there?

SPT It's a lot cooler.

SPT I slept under a double blanket - in other words, the one that pulls up from my feet - last night for the first time. I think Jack did too.

CC Okay.

225 00 52 43 SPT A couple of notes on this last ATM pass. I did a shopping list item 1, a JOP 12D, step 1, a two-limb and 55 alignment, and a shopping list 16, over on the east limb. I believe it was not a prominence - not the prominence associated with active region 85, however. Now on this two-limb alignment, I've spent quite a bit of time going between the North and South Poles here - or up and down the upper and lower limbs, and I believe that 0932 is a better aligned position than 0832. And I think we'll switch over to that - coaligned line, if y'all are in agreement on the ground.

CC We'll let you know, Owen.

SPT It turned out the H-alpha radius to the inner limb is just about 1 arc second larger than the white light radius as seen by the XUV SLIT.

CC Pretty good instrument, huh?

SPT Well it's sort of hard to imagine this limb's very much different in diameter with two telescopes.

225 00 54 47 SPT Another interesting point that - Jack pointed out on the last rev and I've just reconfirmed up here; that is, the prominences are distinctly more visible in H-alpha 1 than they are in H-alpha 2. Even

tried to put it away into a bag and every time I open that locker I still smell pepper, and I've given up on pepper even though - although I'd like to use it.

227 02 21 17 SPT — Any other seasoning is too much trouble to fool with, and so I'm just getting along without any seasoning. Eating utensils are not bad. They need a better place to stow them. That little - my spoon flies out everytime I open the drawer. Have to go retrieve it and have to Velcro it down with that strap.

227 02 21 35 SPT — Sleep restraints need some mods. Al's got a lot of work done on it, but I sleep in mine all right. It's not bad. Trash airlock, Al always does on his own. Vacuum cleaner, I've personally not used. Wardroom table, I've not used it for any noneating use. Tool caddy I've never put on; get along without it; use my pockets. Portable fans, we use those around a little bit for cooling various things. Off-duty equipment kit, we got a tape recorder stashed around; everything else we've never used. Garments - I need more socks; that's the only thing. I should have thought to bring some up. All I brought up was some shorts which I probably can use, but I should have brought some socks up. Light baffle, haven't even put it up. That privacy curtain I presume is the one in front of each of our compartments and they're very useful to keep the light out. Zowie, I am all the way through and I'm rocking out for now, SPT out on 487-something or other; it's page 3-3 and 4.

Ref. 2.19

A-42

227 02 22 33 SPT — End of message.

227 02 32 32 CDR — This is the CDR and this goes to EGIL and I've just completed housekeeping 70D. It's on the schedule for tomorrow, but I just went ahead and did it tonight.

227 02 32 40 CDR — Let me read you the information. EPS - EPS OWS temp, 72. Pressure, 5.1 Duct airflow, 500, 500, and 550. ES - CS heater operation check, I checked them, found the bus amps were 20 and 18 and performed a complete check. Everything passed satisfactorily. The only thing different when I got

to the others. That's about the only one. Should be warmer.

229 22 17 47 CC — Skylab, Houston. We're going LOS. We'll see you at Honeysuckle at 22:24.

229 22 17 53 CDR — Noise level: Okay. Illumination: Poor. All illumination is directly above your head; can't shave under your neck. You want to examine a spot on your face or something, you can't see it worth a darn. Just not sufficient illumination and it's all way up high; shaving your neck or anything of that kind of - depilate, if that's the word, to something else. So I'd recommend we definitely increase the amount of lighting in there for shaving, for getting specks out of the eye, for all those other things. It just isn't satisfactory.

229 22 18 34 CDR — Sleep compartment general arrangements: It's okay. Needs to be much more soundproof; it's very lightproof. Needs to have a door so, if that when you close it's soundproof and gives real privacy. Needs to have an area to hang your clothes. You use a lot of clothes in this business. You use clothes for when it's cold in the MDA, when it's hot here. You got your gym clothes for exercise, and you got your sleep clothes. About the only way you could put them where they could dry out and get some air is kind of out blowing in the breeze on those little re - those little rubber restraints, which are great. And that's bad, it'd be nice if you had a - something like a closet that you could open the doors, put - hang those things in there and the breeze would blow through and keep them dry and cool, yet they wouldn't be out blowing in the breeze.

Ref. 2.21

229 22 19 50 CDR — I think that's about it. Volume of compartment seems adequate; it does need a little more, like I said, closet. But as far as where you want to sleep, it's okay. Ceiling/floor proximity: That's okay. Ingress/egress provisions are good. Trash collection provisions I think are satisfactory, maybe even exceptional. You don't have much trash in there.

229 22 20 10 CDR — Stowage volume and access: You got lots of stowage in there, and most of your personal equip-

232 14 52 10 PLT

The airlock itself - its arrangement: It seems to be satisfactory. During the EVAs, why you tend to float around in there and grab on to whatever you can grab on to. There's usually other items and articles floating around in there, too, and you seem to kick them and bump them. And they're hanging on tethers and getting wrapped up in your legs and wrapped up in one another. And so it's - it's kind of a bowl of spaghetti during EVA, but we've been able to manage with it all right. But I'm sure there are some improvements that can be made to - to store equipment better in airlock areas and keep it from dangling all over and provide places for people to hold on to.

---

232 14 52 56 PLT

Ref. 2.22

MDA/STS area is arranged in a pretty hodgepodge fashion. It looks more like a boiler room than a spacecraft. Next time we build something like that, we ought to make it so things are fared in better and there's not so many nooks and crannies for stuff to get lost into; so many head knockers and sharp objects sticking out from lack of things to grab on to and to fasten yourself down to. The - the general arrangement of the MDA is probably more hodgepodge than any other area in the spacecraft, in my opinion.

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232 14 53 35 PLT

A-43

I - In going from the airlock to the command module, seems like the orientation that you go through there - that I go through there, anyway, always winds me up direction of motion - direction of motion directly at the little table in front of the ATM. So I've always got to grab ahold of it or rotate out of the way in order to miss it. Easy to kick the ATM panel when you're going by. And so our arrangement in the MDA could have been better somehow.

232 14 54 10 PLT

Volume of the compartments is adequate, I think, except for possibly the airlock compartment. That could have been bigger. When you're sitting in there, why it gets pretty crowded with all that in there, too. And could use more room in the airlock. The rest of the compartments, the volume seems adequate. I wouldn't make the sleep compartments any smaller than they are, and I - I can't think of any - Neither the waste

marking them. The tapes come up, and they're unmarked. Except for the ones that were launched, the others are unmarked.

232 15 02 33 PLT They just come in a cassette 1, 2, or 3 indications; so there's no way of knowing what's on them unless you go through every one of them. You can't file them like you would at home, in a - in a cabinet, and just look at the sketches of them, like you would at a book to see what the title is. You got to go through the whole - the whole stash.

232 15 02 53 PLT So my suggestion is that you figure out some way to contain all these tapes and some way to mark them on the outside so that you know what they are without having to go through the whole heap and have them float all over and then they float out of the compartment. You find one or two adrift during the day, somewhere around the workshop.

232 15 03 11 PLT The rest of the stow - The rea - Like we said, there should be more stowage area in the sleep compartment. They're - The lockers that we do have in here that we're not using are full of trash bags or some other thing like that, that you don't use very many of. And so if you just don't empty those lockers, they're not available for personal use.

A-44

232 15 03 33 PLT There is no good way to stow your clothes at night. You can't stow everything on these little rubber towel holders, because it floats all over and it just kind of gets in your face and everywhere. And so you need somewhere to stow your clothes. It would be nice to have a locker to dump those clothes into. And normally what I do is I roll up my shirt and stick it behind the SIA and the light to wedge it in there. An my trousers - I roll them up, throw them in the trash compartment. And then I got T-shirt and a pair of skivvies I usually stick in the towel holders, and they float around. And the shoes - I still got a disposal bag down here with extra clothes in it that we brought up, and I got that bunched into the deck and out of the

Ref. 2.23

way of the vent so I get some fresh air. And I usually stick my shoes down there, wedged in somewhere. But really not enough stowage area in the sleep compartment.

232 15 04 29 PLT Looks like we got enough of it in the wardroom. We're gradually using towels and things out of there, and some of those lockers could be used for other things. I've stowed the T002 hood in one of those lockers instead of folding it up every time and putting it back where it belongs; so I take an empty locker and stuff it in there.

232 15 04 50 PLT Now there aren't too many stowage provisions that are required in the head area. The compartment where you keep the fecal - used fecal bags is a little too small. Seem to be emptying that thing all the time; seems like it's always full. And so that could have been a bigger area. I really don't stow much there.

232 15 05 11 PLT In the experiment compartment, you don't stow much extra stuff there, either. And stowage volume that we do have appears adequate. The area - We'll get things out of there all right when you need them. Up in the forward dome, we're starting to use that extra stowage space up there. That stowage seems adequate. The extra things we brought up, however, are stowed somewhere on the wall or tied to this, that, and the other thing. And we don't really have a place to put them, like extra poles for the sail and that kind of stuff is kind of just lashed down wherever you can find a place. The plenum is completely full. We got one more bag in there than the sched called for. And if you need to put more plenum bags down in there, you can probably improvise a way. But the stowage area that we have planned is completely full.

232 15 06 05 PLT We could go around. I noticed that the cable that is fastened to the dome extends all the way around, although the cable that's fastened to the wall to hook the other end of the pol - plenum bag to is completely filled up. If you need to use more plenum area, you could take it down there and improvise, someway using the cable that goes

do your work, to - to change your urine drawer out, to change the fecal bags and weigh them and put them in the fecal dryer. You're just continually floating around there. You can't even hold yourself down to write something. You've got to wedge yourself against the wall in order to write on the little chart we've got in there. And it's very inadequate, poorly designed from the restraint device standpoint. The airlock module doesn't have any personnel restraint devices and probably doesn't need any. The other place that the restraint devices are poor is in the MDA. We've got a good restraint device in front of the ERFP and in front of the ATM panel with the triangle gridwork. However, any other place that you want to work, you got to wrap your legs around things.

232 18 57 36 PLT

A-45

If you want to take pictures of TV out the window, if you want to work on S192, or if you want to work on the - do the VTS or any other place you want to go in the MDA, there's just nothing to grab onto. You've got to find - find your - some place to wrap your legs around. And so MDA-wise, the restraint devices are something that has to be improved on, also.

232 18 58 06 PLT

Ref. 2.25

Thermal comfort: The temperature has been quite satisfactory in here. It was a little warm in the workshop when we first got here; the sail took care of that. It gets cool in the night when we're sleeping and most of the stuff is powered down. Wind up putting a little extra blanket over late in the mornings. The MDA is always quite cool, and it's uncomfortable to come up here, matter of fact, for me anyway, without any - or in my underwear, which is sometimes the way you work up here because you have to work up here just before you go to bed. And you come up here to get the pads and do some other things. So the MDA is a little cool but tolerable; in fact, sometimes a pleasant place to come when things get a little warm down in the workshop.

232 18 58 57 PLT

Whenever you get the high-intensity lights on down there or midafternoon while we're working, it seems to get a little warm down in the - the workshop area. The sleeping compartment does cool off at night near the ventilator - the - the floor.

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

241 13 35 42 CDR

Hello, Houston.

CC

Hello, how did you know we were here? We're [illegible] through Hawaii for 7 minutes.

CDR

Oh, we know everything up here. Don't forget we're looking down and getting the [illegible]. You got to read that - You got to read the [illegible].

CC

Okay.

241 13 36 06 CDR

Ref. 2.27

Wanted to mention something we were doing that you might pass on to the housekeeping folks that might make it a little easier to Jerry Carr - crew. One of the things we're doing is we got a bag over on the wall by the 131 equipment which is our rag bag. And every time we have old shirts and shorts and the like, which is almost every day, since everything's thrown away, we put them in that bag. Sometimes it gets too full and we shoot it out the trash airlock. But there's always some rags in there; so when it comes time to water clean, or wipe or something like that, we usually go over there and find a clean t-shirt or a clean pair of shorts or something like that - and most of the time they're fairly clean because we change them so frequently - and use that instead of trying to do all that cleaning with these tissues. And maybe they ought to put that as one of the regular plans because it sure makes cleaning a lot faster. I think it gets things a lot cleaner. You sure get them a lot dryer. And it's just esthetically more pleasing to be cleaning up with a rag than it is with one of those little 2-by-6 tissues.

241 13 37 21 CC

Okay. Copy, Al. And while we're on that subject and SL-4, we noticed on the dump tape tha you requested a head-mounted light source. Have you tried out the head-mounted light on - in the [illegible] kit?

CDR

No. We probably ought to. I'll get it and try it out sometime today.

CC

Okay.

but at least I don't have any trouble eating it. And I'm not complaining about that part, but I would like to substitute the tuna if you can find something that would work.

237 21 44 49 SPT And the third item is - relates to the general content of our menu cue cards. I suspect by now you have heard that there is some descrepancy between what is on our menu cue cards and what in reality our menus were supposed to be. This relates to at least the optional salt and perhaps the other items that are included. And this is perhaps a question for - others, Deana and Jean, than yourselves. And if so, you can relate it to them, like Malcolm or Mike Whittle or some of the others involved in the planning for our menus. But I would like to know what is being planned to make our menus correct, as cue cards are, at the present time, inaccurate. I'd like to know why this was not brought to our attention before, and what is planned to be done about it.

A-46

237 21 45 52 SPT This is the end of the message to Mrs. Deana Sanford, Miss Jean Reid and they will circulate it to others as appropriate.

237 21 46 01 SPT SPT out.

237 21 46 57 SPT This is the SPT on channel A with a message to Ed Gibson over in the Astronaut office. Hello there, Ed; got a couple of things to mention to you and some of this relates to Bill and Jerry also. So first one relates to clothing. About the last 3 weeks before launch, why, they came around to say, "What more clothes you want? Pete's group needed more; we're about ready to fix you up," and all that good stuff. And it was too late for us to figure out, properly, what we really needed. Now it turns out what Jack and I really need is socks. We have more clothes up here than we can wear in 4 months, much less 2 months. I'm only about halfway through my first clothing pack, even though it's supposed to be completed at the end of 30 days - or 28, except for socks. Now socks I would have liked to have changed every day, and unfortunately I get one pair of socks about every 3 days, because a couple of them are on long handles and other stuff

Ref. 2.28

that you don't get worn. And so my suggestion to all three of you is - is to see if you can't get more socks, and forget about the rest of the stuff because socks you really need. And at least as far as Jack and I are concerned, we got more than anything else - more than we need of everything else.

237 21 48 17 SPT Okay, that item applies to all three of you. And the next one is perhaps more related to you, Ed, but it'll affect all three of you, too, and that is the film - ATM film in particular. Now the ATM changeout as you know, occurred on day 28, and we really only got into operation on day 11. And for about the last 3 days, we were running with lots of experiments omitted because they were running low on film. So this really means we essentially exposed one complete exchange of film in about 12 days of fairly concentrated work. Fairly concentrated, I say, because we were catching up to about 12 ATM - correction, up to 10 ATM passes per day on a good part of those days. I don't know how many ATM passes you all intend to get, but the point I'm trying to make is it doesn't take long with hard work to expose a complete exchange of film. Now the S054 canister still is in very good on load 2, which I just brought back in yesterdey. And, of course, there's no reason in the world to not reload that thing, Ed. And I expect that y'all are taking care of this or it has been taken care of very thoroughly. But I'd just like to reemphasize the fact that on S054 in particular, you ought to have at least one extra exchange of film to put in that machine.

237 21 49 47 SPT And then as far as 56 and H-alpha and 52 are concerned, you've known all along that those are light cameras, and I think this would be a good time to start bringing up to Kenny the fact that it only takes 12 or 13 days of hard work to expose one load of film. Now with Kohoutek in edition, why, of course you're just not going to have enough film to give the solar observations a fair shake. And I've expurgated your section in NRL because of the size, and I understand we've already got that extra one load anyway. But on the other cameras, doggone it, you really ought to get some extra film, Ed. And I don't think it's any too soon to start worrying about that and getting it pushed through the program office if you can. Now -

238 18 16 53	CC	Okay. You've done a total of 31 telecasts, 13 from the TV Ops Book. All of them are great; 31 of them have been broadcast.
	SPT	That sounds like what we heard last night, Story. And then there were a few comments about technique, and so on.
	CC	I guess you got it already.
	SPT	Thank you.
	CC	Jack, if you're through with your attempt to lock onto Alpha Crux, go ahead and select Achernar to 52012 and a 50000.
	PLT	Okay, I was - I finished up the shopping list item 2 and I can't see the Ellerman bombs on the sun-spot. I wonder-or on active region 8 - wonder if they'd like to have another shopping list number 2, say in that prominence you just mentioned at 290.
	CC	Stand by.
238 18 19 37	CC	Jack, we'd like you to run another shopping list item number 2 on active region 8.
	PLT	Okay, I'll do it again.
238 18 23 38	CDR	Story, are you still there?
	CC	Yes, sir; about another 6 minutes.
	CDR	How about making a suggestion to the fellows that work on these foot restraints? They built us some new ones to go in the wardroom here because of Pete's comments. Mainly his comments were you can't get your feet under there with triangle shoes on because they're not big enough. But we got these up here now and you can't - My comment is you can't get your feet under them when you got triangle shoes; they're too little. So, whatever design they used was erratic and they tended to make them the same height as the old one. There may be a fraction greater because right now you can't get them under if you have the Velcro engaged. So, ask them to have another go at that and get some triangle

A-47

Ref. 2.29

shoes, put feet in them, and stick them under there and make sure that - that that's where the Velcro begins, instead of where it ends. Send six up for Jerry if they can. And then also the ones in the head - they're working better, they're not big enough for Velcros - for triangle shoes either. But the main thing in there is they're still just in the way. They ought to try to figure some different type of restraints for in there; either on the wall or maybe on the ceiling or somewhere else besides on the floor in front of those urine contain - urine drawers, or maybe on the drawers themselves or something. They ought to have another go. We ought to learn to lick this problem in Skylab so when it comes up in shuttle, we'll have a good answer ready. Those are really the only two restraints that seem to be bad.

	CC	Okay, got that, Al.
238 18 25 21	PLT	One thing, Story. I can't seem to get the star out of the window now. I've had a star lock up at the proper angles for Achernar, and - slewed outer gimbal all the way from say, 3300 down to 27, and it says locked up. And it doesn't go back to where - to any new position when I let go of the stick.
	CC	Stand by 1.
	PLT	Now it unlocked again. I'll try it again. Maybe it's going to work right this time.
238 18 26 36	CC	Jack, have you been seeing a star presence?
	PLT	Yes, I get a star in the window and then I slew off a little ways and it doesn't go back to where it was - supposed to be. I doesn't matter - seems no matter where I put it, it - it just stays where I leave it and still says star.
	CC	So you're - you're seeing a star presence over a wide range of outer gimbal angle?
	PLT	Yes, I got a star flag in the - on the flip-flop
	CC	Jack, you can go to AUTO right now; you're close enough, and we're a minute until LOS; we'll see you over Guam in 25 minutes.

and the best way to get them off is just take a wet rag and wipe them down. And all this baloney about - about soaping a place and then rinsing it, then biociding it, then rinsing it again is just too much trouble with it.

239 01 57 28 PLT Some of it doesn't get done and we'd probably do more of it - more cleaning if we didn't have to go through this kind of waste - make-work waste-time procedure. Okay. How adequate is the ATM chair? Never use it; don't need it; and it's sitting back in the corner somewhere out of the way. And it's - To be honest with you, more in the way than anything else. I guess somebody - some guys may like it, but nobody in this flight ever uses it. So I can't comment on that too much since I haven't used it. I used the shoe grids only. Toebar, I don't - never noticed it was in there.

A-48

239 01 58 08 CDR It's on the chair.

239 01 58 10 PLT Well, it's on the chair, so that's why I never noticed it. Don't use the chair anywhere at all. So I don't have any improvement to recommend other than finding a good place to stow it that's out of the way.

239 01 58 20 PLT How come?

CDR ... (Laughter) Put a handle on it and ... (laughter).

239 01 59 05 PLT Number 8. How comfortable are your garments in terms of fit, warmth, don/comf - doff ease? And wear - were they sufficiently resistant to tearing and abrasions? Well, let's go over that first. First things first here. How comfortable? Oh, they're plenty comfortable. I don't do anything to modify them. I just put them on. Sometimes I wear the jockey shorts; sometimes I wear the - the boxer shorts. I think I like to have a clean - clean pair of skivvies every day, and the extra ones we brought up, I think, were a good addition. I don't ever wear the white T-shirts except to bed at night. During the day, I don't wear the - the turtleneck - what do you call it - the duress [?]

shirt either because, I don't know, it's just too warm and it doesn't have the pockets in it that the - the outer garment does, or the jacket does. The jacket's got -

239 01 59 59 PLT The jacket's got pockets in it. Now you can keep pencils, flashlights, and tapes, and whatever junk you picked up along the way in the pockets and - and besides, the duress shirt's not fitting and it's a little warm and it's got that turtleneck to increase the warmth. It looks good but it doesn't absorb the sweat much either, so I haven't used the one - one of them but one day, and - and I decided not to use it any more after that. But of course, T-shirts aren't have - don't give any final authority protection plus they don't have the pockets in them, so I wound up just wearing the jacket with no shirt under it. And it's very comfortable and cool that way. I don't sweat into it, so you don't get it all sweaty and it's not sweat up here unless you're working out on the bike. And - and so I motate around that mode: trousers with a pocket full of junk and - and the jacket by itself with whatever stuff I need to pocket in them. Another thing you don't have enough of up here is socks. You should have a extra clean pair of socks for every day. I don't wear them - those longhandles at all. I don't need them, but - the temperature's just right. We were't sure about the temperature to begin with. But I don't need them to sleep in. I prefer not to. And so underwearwise, all I wear is skivvies. Other comments: I need one pair of socks a day, one pair of skivvies a day, one pair of trousers a week is about right, and one jacket every 2 weeks is adequate - swell.

Ref. 2.30

239 02 01 27 CDR Hey, try to ...

SPT ...

239 02 01 32 PLT Were they sufficiently resistant to tearing and abrasion? Yes, they don't tear or abrade. I had one that the pocket came off from. One pair of trousers had the - Yes, I put that down.

239 02 01 47 CDR I'll be back in a second.

239 02 01 48 PLT Okay. Thank you. Before and after dressing or something. The one that is the pocket that you - the hip pocket that you keep the little checklist thing in. And one of them was - came loose and started tearing off. That's my problem I'm having with them. They fit good. Pencil pocket works good and the little pocket for your PRD works good, your dosimeter. And it's that other pocket back there for your scissors - doesn't work good at all. It's not big enough to keep the scissors in. The scissors are too long for it. It keens coming loose and the scissors come out. Too much of a nuisance to hang them on a lanyard because you have to unwrap them every time you want to use them, so I wind up putting them in one of the other pockets. That scissors pocket is no good for nothing. So that's the only gripe I got about that.

Ref. 2.30

239 02 02 39 PLT Let's see what else. Do they tend to snag as you move about? No, they don't seem to snag. Recommendations for improving the garment. Well, I think they're adequate the way they are. I - I like them okay. I use my lower left pocket for trash, junk; every place I pick up some trash I put in there and I hardly ever empty it. When I - I just leave it full and throw it away when I throw away my trousers. My lower right pocket, why, I use that for picking up equipment that I might want to use. There's always restraints, and bungees, and stuff like that, floating around and - and hooked to places where they are not being used, so when I see one and I know I'm going to need it sometime, I pick it up and put it in that pocket and I use it sometime. In my left side pocket, I - I keep my tape and my timer in there. Always need that tape. The gray tape works everywhere, so I keep some handy. Always need the timer somewhere, too, so I can keep it handy there. My right side pocket, that's the - the flat one, I put my scissors in there and - and I can't remember what else - whatever else I need to carry around. Oh, I like the garments pretty well. The ones - the parts of them I've used. There are some I wish I had more of.

CDR Okay. We'll put it down here and then I'll - you're right. Thirteen's going to - he's going to be ready in about 10 seconds so I'll get on it.

241 15 10 43 CC Going LOS in about 30 seconds. We'll see you over the Vanguard in about half an hour, at 15:43.

CDR One thing I've noticed up here. You don't trip much.

Ref. 2.31

CC But how about the poor head.

CDR You don't seem to bump it either. I've been a little bit amazed. I don't think I've had a head bump since I've been here, and I haven't heard anybody else complain. The thing you do do is skin up your fingernails and knuckles all the time.

241 15 11 14 CC Okay.

241 15 44 07 CC Skylab, AOS through the Vanguard for 10 minutes.

CDR Hello, Story. Are you still there?

CC Yes, sir.

241 15 46 36 CDR Okay. Let me tell you what we did with T013. We ran through the calibration. I gave them five data Marks instead of two and then at the end of that, I got the force gage, pushed in on the center on both FMUs - 5, 10, 15, 20, 25, 30, 35, 40. I kept pressing and calling out the numbers in the center and took the force gage and pushed on all three of the bolts that hold down the double force units on both gages - gave them the same thing - up to 40. Then went around and pulled on all four corners of the ... - on both units. And then got in all four sides in the middle - on the side, on the edge, in other words, and pushed the opposite direction. For example, if I was on the interior edge, I'd push to the anterior edge. Now how's that for a medical talk? And if I was on the top, I'd push toward the bottom and that sort of thing.

241 15 47 30 CC Okay. Copy, Al.

encountered? I think probably the urine ... on the end of the ...; ... you can. ... have to ... drops out and then you immediately have to get a ... somewhat and wipe off. Your fingers get dirty and get ... to the tissue. And with those rubber ... because you get rubber ... with urine on it. And then you have ... urine on it. I think ... could have invented a cuff with some sort of ... flows through there where it could - you could catch the ... of your ... there and ... could ... off ...

239 02 21 04 CDR — How effective and efficient are the cleanup procedures and hardware? They're okay. I think the little wet wipes are too small. In fact, ... okay. It's just that they ... nice job of ... trays, they can clean them out here and you have no problem. The procedure where you wipe stuff with just soap and water isn't as ... biocide procedure. ... clean it as good ... hospital. It ought to be able to just wash it with water and then every once in a while ... germs build up ... give it a biocide wipe ... sufficient ... clean up of biomed bases ... with the biocide. Clean up the trash area ...; other areas ... clean ...

239 02 22 07 CDR — How adequate is the ATM chair? Tried it one time, thought it would be good - ... rattled around. It's the same feeling you have in a - a - a chair that has one leg shorter than the other three. It's disconcerting, troublesome, bothersome. ... Now ... the chair wasn't clamped to a grid in front of the ATM. The fact was that the grid itself is loose, so - It's just bothersome. Now have it parked. I think it would be a good thing if it were done right and anchored down ...

239 02 22 43 CDR — How comfortable are your garments? Excellent garments. A little too many pants, a little too many jackets. One would last 28 days, certainly the jackets; pants every 2 weeks. Things don't get dirty up here. The only dirt you get on is your shirt; food and things fly at it, and sweat from your body, which isn't much up here, I notice. And sweat doesn't stink. By that, I mean - I've noticed that nobody seems to have body odor over here whether or not you use a deodorant.

Ref. 2.32

239 02 23 07 CDR

Now on Earth in the same situation, you'd smell. Our clothes got to smelling bad there - on Earth after a day or two, particularly these shirts. But here they don't. And all I can imagine is - is the fact that we just aren't putting out as many salts and minerals, or they're going somewhere else, probably out in the urine. Do they tend to snag as you move? No, they're good. Pockets are not ... I like the full pockets; they give you the ability to stuff a lot of things in there ...; ... those pockets ... for different things ... and for ... less than for trash ... trash ... most likely to ... you there ... - -

239 02 23 44 CC

Skylab, Houston; we're going over the hill - hill. Med conference will be at Madrid at 02:28.

239 02 23 51 CDR

- - ... My ...; my flashlight ... get to. My ... helps and my ... So I've got everything sort of where it's needed. I know where they are just a few days ... The knife pocket and scissors pocket and the ... pockets are too small. They ought to ... snap on them instead of Velcro. ... Velcro isn't much ... They need to overlap the pocket more so that things wouldn't ... opening. Actually, the opening of the scissors pocket ... trouble ... That's the recommendation I had.

I need more socks here, and I need a pair of shorts every other day, socks every day if possible ... us to ride on the bike - dirty socks ... do it. I think you need - triangle shoes. You need a pair of low-top triangles and a high-top pair for riding the bike. These things get hot here and there's no reason for ... The other little booties, forget them. You don't ever need them. ... socks ...

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239 02 25 04 CDR

What changes have you detected in the environmental elements discussed as the last question in the first debriefing? Well, nothing. ... a little cooler since we put up the twin-pole sunshade. It's nice down here, not bad. I slept in the MDA a couple of nights. Now I don't do that any more. One thing that I have noticed is - my nose is starting to - not bleed - hadn't - blood in it - let's say, scabs in it when I blow my nose, and so finally I think that I'm adapting to the dry climate. I've noticed that I have the same

243 02 00 11 Ref. 2.34	CC	With respect to your question on using old shirts/ shorts for general cleaning purposes, that's fine by us. But we don't want you to leave any wet items for any period of time in a rag bag. That is, if they're wet, why dispose of them in the trash airlock per plan.
	CDR	Okay. That's the technique we've been using.
243 02 00 34	CC	All right, with respect to M509, what technique do you use when changing the PSS bottle and battery during a run - i.e. do you dock to the donning station or does the test pilot hold on to some object while the observer changes the bottle and battery? Over.
	CDR	We've used both techniques, depending on just how the - the test pilot feels at the moment. Lately we've just been holding onto the donning station and doing it form there. Either way's acceptable. If you want to get into the donning station, that's good - You usually have to tip the guy up. It's a little bit faster if you do it hanging on, we've noticed.
243 02 01 15	CC	Roger; we copy. The second question, how do you come out of the donning station? Do you fly out or does the observer pull the test pilot out? Over.
243 02 01 24	CDR	It's a little tight to fly, so usually the test pilot just kind of pushes himself out, while the observer holds the rod. Then after he's out, the reserver - the obsever releases the rod so that it won't be spring-loaded in the little locks. The only thing that we've found difficult is getting bact in. It's difficult to get back in - the test pilot by himself, the observer usually has to go over and center him and then sort of push on the unit at the same time he pulls on the handle and then releases it.

END OF TAPE

ground, when we've got some time to do it, instead of wasting too much of this time for things that we could do as well on the ground.

244 21 25 15 SPT

Beneficial and detrimental effects of zero g; individual work activities while restrained: Well, anything having to do with something heavy is much easier and it is beneficial to have in zero g. If it has very many parts, if you have to keep laying stuff down, then it's a hinderance. So - I think as far as your - just normal work activities in general, zero g is a hinderance. The reason we're up here, it seems to me, is the fact that first of all, we're above the atmosphere. Secondly, it's a brand new environment, so its vacuum is important. And third, there's a - a number of specific things like heavy masses, like a bunch of new - types of tasks that could be - could be performed without gravity, like the crystal growths and we were doing that. But those sorts of things - those are the reasons that zero g are - are of benefit. As far as our individual work activity, our ordinary things like eating and drinking and - writing and so forth, all that stuff generally, zero g is a hinderance. It is not a particularly significant one. It's one that you can work around. But it's not a particular advantage, except in those specific things that I was mentioning. Handling, transfering is very - It's almost always an advantage and very naturally in zero g. It's really much simpler. You can really coast around with no - no effort and do things with precision. The required assistance usually - stability and tying yourself down would be the principal problem. But other than that, zero g is satisfactory. It doesn't make a lot of difference either way.

A-53

244 21 26 55 SPT

Personal maintenance activities - hygiene, donning, doffing: It's more of a problem in zero g. Personal hygiene, you can tell by what we've talked about in the head. It's more of a problem in zero g. But you can get around it. There's nothing so big that it's a big everyday problem. But it's, nevertheless, not as simple and straightforward as it is in one g. Had we spent the last 30 years up here, we'd have probably devised things that would have made it more simple. And it would have been comparable. But

Ref. 2.36

at the moment, it is not. It is more of a problem.

244 21 27 25 SPT

Donning and doffing is a little bit more of a problem here, except for some things having to do with heavy weights. But personally we find getting in and out of suits is usually a little bit more of a problem. Although it's nice not to have to hold the suit up, still it's a little bit more of a - of a - a problem, and you take a little bit more help getting in and out.

244 21 27 46 SPT

Waste management and cleanup, we talked about that when we were talking about the head. So it's a bit more of a problem. Locomotion in and through. Well, going up to the top is certainly a lot easier. You can fly straight to the command module with no problem. So any time you've got to go up or down in one g, it's a lot easier to do it in zero g. Any time you've got to go horizontally, it's probably easier to do it in one g. So your answer depends on which specific thing you're talking about.

244 21 28 14 SPT

Satisfactory in frequency of bedding and clothing [sic]? We don't need to change as often as we have, with the exception of the socks, I think, at least for myself. And I believe Al and Jack would have preferred to change socks every day. We didn't have that many. The rest of the clothes, more frequent changes than we really need. You just don't get as dirty up here because there's no dirt or grime. And about the only thing that gets on them is a little food maybe - a little bit of urine maybe. We change our underclothes, of course. So there's no real problem at all. The frequency could be less, except for socks, as far as I'm personally concerned.

244 21 28 50 SPT

That's the end of this briefing 2 Charlie, from the SPT.

TIME SKIP

244 22 07 15 CDR

Okay, this is the CDR, and we're doing S019. I've got it set up on 232.8, because the actual's minus 2.2 and the pad is minus 30; 21.9 TILT;

day, Jack Lou - I mean Owen was in the M509, which weighs a couple hundred pounds. I couldn't lift it. He was in it and I was moving him around with one hand. That sort of stuff is great. Now when I got ready to change out the bottle, lifting the bottle's ...

245 00 42 56 CDR — But trying to dive under there - By the way, another thing that's easy here is getting into small spaces. You can turn around and dive underneath between and around and among is - is much easier. But anytime you have to anchor yourself down ... Now how that helps, I don't know. Personal hygiene: Easier on Earth. Everything drops all the time instead of having them floating around. Same thing donning and doffing ... They're easier up here. You just kind of float up in the air and put the things on. Much better. You stay cooler up here. You don't work too hard.

245 00 43 30 CDR — Waste management and cleanup chores: Waste management is harder here because systems are evolved for gravity, you know, and urine drops. That's nice. Fecal matter drops and that's nice. The cleanup chores are easier on Earth. But I'll say this gets dirtier because items don't tend to fall in the same spot; they're all around. So things can - you can spill more things and still it won't show up, if you know what I mean. They just disperse over a large area.

245 00 43 59 CDR — Locomotion in and through various compartments: Locomotion is easier for distances in zero g. Now, if you want to stop and anchor yourself in zero - either one, but to get anywhere - I can get anywhere almost up here faster than I can anywhere else. Certainly it was easier.

A-54

CDR — How satisfactory is the frequency in change of bedding? We're changing too much. Ought to change them once every couple of weeks. Sheet doesn't rub you as much. You're clean up here and you're not laying on any bedspreads to get them dirty. You're floating between and that makes a difference.

Ref. 2.37

245 00 44 36 CDR — Clothing: No point in changing it too much, except for socks. I would recommend that a change of jacket once a month and a pair of pants every

couple of weeks, a shirt every 3 days - that'd be adequate. Now - shorts every day, probably but ... I don't know, it depends on how fancy you want to be. I could live with the same clothes for a week; it ain't going to hurt me. Done it before on camping trips. Thought it was great, but - when I'm home I change once a day. So, I don't know. It depends on - I would change shorts every other day; socks every day; and pants, once every 2 weeks; jacket, once a month; shirts, every 2, 3 days.

245 00 45 16 CDR — CDR out. And that goes to the M487 folks.

TIME SKIP

245 01 22 31 PLT — Okay.

PLT — Now.

PLT — Hey, can we begin?

PLT — Can you get - can you get me and the rest of the place in down there?

SPT — ...

PLT — Okay. Oh, I just want to be able to see the trash airlock clear on through and - and I'll be here talking.

PLT — Okay. And then that and that, that, that, this, that, and that, and that. Okay, (laughter) you got all that? Okay.

SPT — ... over there?

245 01 23 50 PLT — No. Thank you.

245 01 24 00 PLT — Hello, space fans. We thought you might enjoy a brief tour of the Skylab, America's first space station, with us up here at 275 miles, whirling around the Earth at 18,000 miles an hour, and having a sunrise and a sunset every hour and a half. At the moment, you're looking to the very base or the basement of the workshop, where the crew

245 23 42 54 PLT — Work - Let's see. Work activities requiring assistance from another crewman. Really, you very seldom need another crewman to move anything around. You can usually do it by yourself. Handling equipment, heavy loads like S073 is no problem here. Just one guy can do that with no problem at all. Or S183 - any of those things that we used two crewmen for in one g, and it called on the checklist to use two guys here, are unnecessary. If we got one guy working on another one to, say, suit him up or something like that, you got to get him in his suit restraints - the foot restraint, and the other guy will have his legs wrapped around him somewhere, zipping him up. And so activities involving two crewmen are less of a pain in the neck than they are in one g.

245 23 43 48 PLT — Personal main - maintenance activities: personal hygiene, donning/doffing garments, and so forth. We found that it's easy to get your legs in a suit and that you can get it over your head, but that it's very difficult to get it zipped up compared to one g. That's one thing that's tougher, is to get your suit zipped up. Donning outer garments. I guess this is one of the few places in the world, and some of the few personnel in the world that are able to say with a straight face that this is the only environment in which you can put your pants on two legs at a time. And that's different than anybody else. So we're not like everybody else. We don't put our trousers on one leg at a time. We put them on two at a time. And it's quick!

A-55

Ref. 2.38

245 23 44 41 PLT — Okay, doffing garments. It's easy to get out of your suit - out of your - your spacesuits. Lot easier than in one g. But there are other things, like personal hygiene, that are no problem at all. The - You have trouble cleaning your razor, but I guess that's not so much a function of zero g as that you don't have a lot of water to blast over it, but you can get that done, too. I use the shaver - the safety razor once a week and the little shaver, the - the mechanical shaver the rest of the time; so personal hygiene is not a big deal.

CDR — The reason the heat exchanger fans are not on is because the thermostat's set about 70 down here. The temperature is about 69-1/2.

CC — Okay, that was a bad call, and we - we caught that afterwards. EGIL noticed then that we probably were in a heating cycle.

249 16 47 47 CDR — Tell EGIL if he'll keep us out of trouble, we'll keep him out of trouble.

CC — I think he copied that.

CDR — Yes, I thought he might. Who is EGIL today?

CC — Sy.

CDR — ... It's fairly cool down here now. In fact, when you're down here and you're not working hard, you have to wear a jacket. So we moved the thermostat up to about 70 hoping it maybe wouldn't be quite so cool.

Ref. 2.39

CC — Okay.

249 16 48 23 CDR — Makes great sleeping, but it's a little chilly for laying in the LBNP, for example.

CC — Yes, this is an unusual thing for us. We haven't - haven't seen the heater on that much in the mission.

249 16 48 41 CDR — Roger. It may be the first time. I don't know. We'll probably have it here for quite a while. There's such a lag in the thermal here. We'll probably have it by the time the data then goes up another 15 degrees or so, and then I guess it'll start getting warm again. Sure been nice sleeping, I know that.

249 16 49 05 CC — Skylab, Houston. While I got you here, we promised prior to mission that we'd keep you advised to the tape recorder configurations, if we made any major changes. And we made one several days ago, and I don't know whether they got the change up to you or not, so you can configure panel 204. We're

the center line between the - workshop - the airlock and the - and the - command module, so you've got to divert around them. And like I said, there's just nothing to hang on to.

246 00 55 07 PLT So, locomotion in the MDA is - is - is - not worth much. Or it's - Locomotion is bad - if you can once you get moving and there's nobody in the way, locomotion is no problem at all. But as far as - getting around - by hand - hand over hand, in the MDA, you might as well forget it. It's - It's - a hodgepodge of - things that you can't grab onto. Question number 7.

246 00 55 36 PLT How satisfactory is the frequency of change of bedding and clothing? Frequency of change of bedding is about right. Frequency of change of clothing is - for the trousers and the - jackets is about right. The T-shirts I don't wear; I think you ought to have - one of those a day, if you're going to wear them. I've got a lot of them left over and - and - don't plan to use them. I - just wear the jacket over my bare skin. And - it's cool that way. It's - There's nothing tight. When I want to exercise, I don't have a lot of clothes to take off. I've got fire protection and - I've - I've got places - pockets to carry all the stuff I want to carry around. So that's the best way to go. You do need one change of skivvies a day. And - we brought up extra underwear and - I'm glad we did, because - I think one a day is a good idea. The - most - short-supply item is the socks. This is - We should have one of those a day. And we don't have it and - I think we need it. So I'd recommend to Jerry that he bring up - enough socks that he can make it one a day. I don't use the long handles of any sort. So - I didn't need them. Thought it might be chilly up here sometime, really didn't know but now we're here - it turns out it's - warmed up. The - temperature's right - so long handles are not required.

Ref. 2.40

A-56

246 00 58 01 PLT I don't use them. The shoes are the other item. We put the - put the toe caps on. We certainly need them. For some reason, we all seem to be - rubbing off spots on the heels two spots - either side of the - the vertical - reinforcing strip. It's about an inch and a half off the sole. They're wearing through for some reason. My - additionally,

my right shoe is - The stitching is coming loose along the bottom sole - about - midway along the foot - opposite the arch. And - the stitching is about an inch and a half there, where it - the canvas is ripped up. And - so, the shoes - by the time we get through the mission, are going to be pretty well worn. And they might even be marginal; I'm not sure - as to whether or not we can make it with them or not. But - we might have to just be a little careful with them. But - shoewise - the triangles do the job. The - outside of the shoes are wearing out though. So - that kind of takes care of - M47-2 Charlie. I've got to run to the ATM. And I wish you'd pass that information along to Bob Bond and other interested parties.

246 00 58 18 PLT And this does finally end this debriefing. Thank you.

TIME SKIP

246 01 10 37 SPT Okay, comment - from the SPT, channel A, for the EREP Officer. The number of frames used on the third pass of the day with the prime ma - this was the second pass with the prime magazine; third ETC pass of the day - was 27 frames. So - that's these - on the prime magazine, 83 on the first pass, 27 on the second pass, is a total of 110 frames used out of the ETC 04. And the spare magazine, black and white something or other - used 24 frames, as I already reported on the real-time down-link. So that should bring you up to date on how many frames we used today and you can compute how many we've got left. End of message for the EREP Officer from the SPT.

246 01 11 39 SPT Okay, here's the SPT on channel A, with a message for the ATM PIs and planners. Over the course of the last couple of days, we've had a chance to observe quite a few isolated - quite a few initial phases of subflares and flares, at least small flares. And - it's been my general observation that the XUV and H-alpha rise in intensity very closely together. And that - for example at the moment, we have about eight active regions on the disk of the Sun, all of which can be seen on the

you got all your Velcro on your card or vice versa. So that stuff doesn't work good.

250 14 59 09 PLT — The S190 maintenance kit: Fortunately we haven't had to use that very much. The items that we have used have done the job all right. But it's only been minor things like - Oh, well, we haven't used the wrenches. We haven't had to replace much equipment. The items that came up in the special kit with S192 work satisfactorily.

250 14 59 45 PLT — Just a ... gage and I can't remember what else.

250 14 59 48 PLT — Didn't really use much on the S190 maintenance kit; so it's pretty hard to evaluate that equipment.

PLT — M512 tools: We haven't used any of them on this mission. We don't have much to do with M512 on this mission.

PLT — EMU maintenance kit: You'll have to get somebody else to evaluate that because my job during the EVA prep was to do other things and the other two guys do the EMU maintenance.

A-57

PLT — Okay, adequacy of work sites: Well, you take whatever work site you got. Whether it's good or bad, you take whatever it is.

250 15 00 22 PLT — I guess you recognize that we've been doing a lot more maintenance up here than anybody expected we would. And basically as far as doing work tasks are concerned, I don't see a whole lot of difference from doing them here than you would at home. The only thing is you got to hold things down. You can't lay them down. You got to tape them to something or - or - One handy thing is just to lay out a piece of tape, sticky side up, and stick yourself to it.

250 15 00 51 PLT — Nuts and bolts, pieces or tools, sometimes I use the tool caddy. If I've got lots of parts to contain and lots of tools, why, I'll take that out. Otherwise, I'll just stick them in my pocket, stick the bolt on a piece of tape or something like that. The tool caddy - little pockets with the windows in them come in handy to keep nuts and bolts in. The - the little rings on there are - clips them; and dog clips have been used to

Ref. 2.41

hang onto some of the tools and ... Velcro and the little pockets with the - in the elastic. So the tool caddy is kind of useful for when you want to - to - to retain lots of parts or lots of tools.

250 15 01 40 PLT — And I've never worn it around my waist. I've always just stuck it somewhere. So really, the waist belt hasn't done me much good, although different guys may use it different ways. Mostly, for me, a pocket is to carry things to a certain - location in. And then I'll fasten them to the wall or stick it up somehow so that it's within reach but not on my - on my waist. Some of the work sites we've used, other than those locations that the work needed to be done at, were - That is, some of the work sites we've used which are other than those at which your actual work is being performed have been on the food lockers, for example, a nice big flat surface. Put springs (?) on there and hold things down and work on them. Stand there on the grid, support yourself, so found the food lockers been a good place to work.

250 15 02 37 PLT — And I worked on the tape recorders there. Also at the top of the waste management vent filter cover is another reasonably good place to work until we have better ways to hold things down. But it's a nice flat surface and about desk height. Fasten yourself down next to it and go to work there. Other work that we - we've done has mostly all been done at the site where the job needed to be done. You just take what you get when you get there, figure out a way to wrap your legs around something and go to work on it, is about the only way to do it. But as far as performing tasks is concerned, there's not much difference in being able to do the job than there would be if you were at home.

250 15 03 17 PLT — Adequacy of lighting for work tasks: In some cases, okay and in most cases, it's not. In most cases, you want to inspect something or look at something closely or find out how the nuts and bolts come off in the preferential order and all that sort of thing, you got to get out a flashlight to take around.

251 02 43 47	CDR	We ought to have a couple of bigger screwdrivers than we've had. Next, I'm looking now at the sockets. The sockets - We ought to have a full set, and they ought to be in a row. Here we got them kind of mixed up, and we haven't got one of each. We got up here and tried to fix our - by the way - tried to fix our exerciser, Mark I, and we didn't have the right kind of Allen wrench and that's a problem. We ought to have a full set of every one of these things. They just don't weigh that much and then you got a full set of tools you can work with.
251 02 44 16	CDR	The wrenches aren't too bad, but once again you need a full set - mechanical fingers. Now here I'm looking at the bottom drawer and here's some more Allen bits.
	CREW	...
251 02 53 47	CDR	Okay, this is the CDR back again talking about 487-3. And another thing that keeps coming up is the fact that we're always - We're never using our tool pouches. Those little tool pouches we got nobody ever uses because they're so much doggone much trouble to go get. Also just getting a big bag and putting them in them tends to let them float away. We really should have invent - Now we put them in our pockets. But we really should have come up with a better tool pouch than what we have. I think the thing could have been merely three or four visible pockets with snaps or zippers. And then you'd have places to put the springs and the screws that you can see them and a way to get in there and reach them. Now we got that sort of a thing on this one, but it just isn't adequate. It's too small. It doesn't carry the tools. They fly off. The whole thing is a bomb, and it just doesn't hold things correctly. It's not secure enough. You should tether them, and it just doesn't have it. And it's a lot of trouble. You end up putting them in your pocket, and you can't see in there, and you open the lid, and five screws fall out, and you have to go get them. So those sorts of things are - are bad.
251 02 54 54	CDR	Another thing that's bad is it's difficult to remember which drawer's got which items in it. Not only do the drawers have the writing near the top

A-58

Ref. 2.42

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

252 12 35 18 CC Skylab, this is Houston through the real Vanguard for 10 minutes. Over.

PLT Okay, Bruce.

CC We copy you're at 10,000, standing there in the DAS. You can go ahead and clear it whenever you feel like it.

PLT Okay. Thank you. We're all up and at 'em.

CC Was that a lousy pun?

PLT Yes.

252 12 35 53 CC We got one low-priority question here. Sometime, when the SPT gets a little while, could he comment some more on the sock shortage. We understand on mission day 37, he reported that he needed additional socks. And looking around, we find that there's some SL-2 garments, union suits, and constant wear garments, that have intergral socks that could probably be cut off. We'd be interested in hearing some more details from him. Over.

A-59

Ref. 2:44

252 12 36 20 SPT Okay. I'll give you a low-priority answer right now. I hadn't been aware of any SL-2 stuff still laying around, but the sock question has managed to get solved in about the following way: I only had 12 per package, as I recall, 28-day package, which is either - slightly less than one every 2 days. But Al brought up an extra big supply in this command module resupply that was done there in the last month or so before launch. So I borrowed a few from him and - permanent loan - and that, plus just not changing socks every day, has now left me in the state of having one per day. So there's no more problem involved. As far as extra clothes is concerned, the only thing that I personally have found that I was short on was socks. And I'd like to make sure - I'd recommend to the ensuing crew that they add on only that one item, if they're going to add on anything. And that is just to make sure they, from the start, have enough for a change of socks every morning. That's all.

252 12 37 23 CC Okay. I understand you feel it's necessary to use a fresh pair everyday?

SPT Not necessary. It's just more comfortable and convenient and desirable.

CC Okay. We copy. Thank you.

PLT The thing is, Bruce, your feet get pretty sweaty in these canvas kind of shoes with rubber soles and - especially when you're riding the bike, you have a sweaty pair of socks.

CC Yes, sure. I was not trying to give you the third degree. I was just trying to get some words establishing the fact that it was probably desirable to provide a pair of socks a day.

PLT Yes, I understand, Bruce. I was just trying to give you a little more information as to how they get that way, and it's just not unusual. I guess if you were on the ground, under the same conditions, you'd- at least I'd want a clean pair everyday. It's kind of like going to the gym, you know, and using the same pair of socks every day. And it doesn't take more than 1 day to get them in pretty bad shape.

CC Roger. Out.

252 12 42 59 PLT Are you still there, Bruce?

CC Yes, indeed.

PLT Okay. Here's one thing I don't understand - I notice that we're going to terminate this M557 this afternoon. And then we're going to let the thing just sit there and cool it until tommorow, and then we're going to start all over again. And it seems like we're wasting time there. We're not going to get all these 10 sets of specimens completed by the time we leave. So I wonder if the planners could think about cycling in a new set of specimens this afternoon when we terminate the ones that are in there now, so we can get them going and then have them done by tomorrow.

hatch lid, you know, the cover instead of the hole, you couldn't do it. Now we kept the metal one in here for about a week, and then we decided to take it out and we hadn't had it in here since, because it's a lot more fun to dive up and down and float. It's just more fun to operate. You don't need it and it's - it's - we haven't missed it. It's - it's been a lot more fun.

253 02 25 29 CDR

Let's get back now to where we were. Okay, you'll see the bottles. We - The way we work these bottles, by the way, is as soon as we finish the run on 509 or T20, if we have a bottle change in midrun, we stick it in there changed. But the bottle we take out, then we go take up and charge it. Then when we bring it back and charge the other one, we stash it there and then the next morning we take them both back and - and top them off. We don't even wait for the ground to tell us to. That way they're always topped off and we get ahead of the game. And there's no reason not to. It really - it really works good. Now I'm doing a bad thing here. I wasn't paying attention and let my triangle shoes get off, and I'm floating away. Sometimes you float up in the workshop and it takes you a minute to get back, so I'm coming back now.

A-60

253 02 26 21 CDR

Okay, by the way, there's where we pu - Let me show you where we put the - the EV plate. And you don't need to change around. There's one. We got it where EV-3 works. Another thing I might mention we found it extremely difficult to get in the suit with our feet in there, because we just couldn't bend over to get in the suit - itself. Well, we were finally able to do it by working awfully hard. We found it much simpler to - get in the suit with your feet in those - and then before you try to put the top part in, to take your feet out - and then just hold on with your - let the other guy put his feet in near the top and he kind of holds on to you and then you can bend over much easier and get in the suit. We found no trouble at all then.

Ref. 2.45

253 02 27 02 CDR

Also getting out is the same way, so don't try to stay in there when you do it. Usually it's easier if the other guy just kind of puts his legs around you and helps you with the suit. Now we

found another thing, it was hard to zip up the suit, mainly because when you lean up here you don't have gravity helping you lean - and so - you don't lean as far. And we kept saying, "What's wrong? We can't zip these up." And finally the last time we did EVA, we just grunted and bent, you know, put a lot more muscle in leaning over. It was no trouble. So it's strictly the fact that we didn't have the gravity and weren't pulling hard enough. We were pulling Earth strength and - and not up here with a lack of gravity.

253 02 27 39 CDR

Let me show you the other two. This one's over here by the bottle. Owen took a picture because he's working underneath, you see. And this one's right in front of the hatch. You can see we keep it open. We don't move it around. You ought to just leave those there. Let them put the hatch in, put those little blue things there; there's as good as anywhere else. And you can float around. By the way, in your suits you don't have any trouble getting from here to the hatch or anywhere else. Everything's great as far as - getting around in here in zero g.

253 02 28 08 CDR

Okay, let's go back over here. Right now we're venting down - we were venting down; Owen just stopped. The lid was open, we were just venting down the AMS - now let - let me talk a few minutes about that thing. It turns out that you get this thing in and out a lot. Along with - with the - the other component there, the - I forget what you call it. That's articulated mirror system and that's the - the adapter. I forget what you call it, let me see what the name of it is. It's called the - S019 optics, that's right; the optics part of S019, and then of course the film canisters over in the film vault. But - you get those in and out an awful lot. If I were you, I'd do extra training on that putting in and out. It's funny, we trained a lot across the board to try to even everything out. But some things you do every single day, like that. You ought to be able to do that as good as ATM. You ought to have five training sessions on putting this in and out alone, before you come up here, because you just do it a lot. And then something like - configuring for EVA - quit doing so much of it, you just don't do it that often. And - you

Ref. 2.46

our - our - food locker - in our [illegible]. And behind it is a couple more items of - extra food. Down there, we've tied down some of the extra clothes we've brought up. We got a lot of clothes up here, Jerr, and you can probably bring some extra socks and have plenty of clothes for any extension you can come up with. Here's where we've put the - fecal bundle. It's kind of stowed over there in the corner, that's [illegible] that we - use one can of - food, one of these big things of food, you know, in 6 days and we fill up one of those fecal things in 6 days. It turns out that - Owen was the first guy to notice that, since he carries out the fecals and puts them in there. I always - and Jack usually - Jack and I put down the food; sometimes Owen gives us a hand. But anyhow, he noticed that - and Jack got mad because he said that - he figured he was just a middle man for the whole thing and he was going to throw some of the stuff in the - in the fecal bags and forget it - cans and all (chuckle); even throw the menu and - the pills in - but he didn't do it. But maybe, who knows -

253 02 32 36 CDR

A-61

Okay, let me show you inside some of these babies so you know what's going on. Up here at the top one, I'll open it and back off. Some will float off and I'll have to put them back in. Okay, now there's the - the leftover stuff that SL-2 had. Now, you're se - Pete's listed them on the top in some places, side some places. But we'll bring back a complete inventory of what's in there, so that gives you a feel for the sort of food he's got in there.

253 02 33 08 CDR

Okay, that's going to float out. This locker contains SL-2's flight data file - SOPs - the - I took off the leg guards around the dome lockers and - I'll just kind of show you. That's just jammed up with old gear. For example, we got ready to go EVA; we couldn't find the adapter that put the powerpack on the camera. We looked all over the place; Jack says I'll bet they threw it away with the - powerpack they used. I says, "Wait a minute. I think I saw a powerpack in here." I went in there and looked and I'll be darned if - it wasn't there. So we tend to not throw much away, but stash it somewhere and report it to the ground; you might be able to use it.

when you punch the button down here on the post, to sure that you punch it like you squeeze off a trigger. Maybe marines know that; I don't know about you, Bill, Air Force. El Gibson, he probably doesn't do anything like that, but marines know how to squeeze them off. But if you - if you wait until everything's quiet and then squeeze it real easy, believe me, you get a lot better sealing. If you don't, you just waste a lot of time up here trying to get three of them close enough to reject. Usually know, we can hit it off the three times, but it took a long time to - to really get it down, particularly locking the thing. That's about it up here - looking around now, I - I don't see anything - He wants to show you inside the film vault; nothing too much new there. Let me - I'm going to unplug this and move down to the lower area and work down there. So hold on.

253 02 38 26 CDR

Ref. 2.47

Okay, here we are downstairs. Let's see how it works down here. Let's start over here right to the left side. You'll see things out of position here. That's probably the way we have them most of the time. Okay, there's the - transuranic rays - nobody knows what that means, but - there they are. Now right there's our clothesbag. We just put a TSB there - not TSB, but a disposal bag there. We put our dry clothes in there that we think we can use for rags. Turns out rags are the - a real winner up here, particularly when it comes time to clean up. Trying to clean up with these little - I'm talking about cleaning the inside of the head or something like that with - with - with those little paper things is rea - is a waste of time. We use the paper things for food and wiping off urine and things like that - off ourselves. But we use rags for almost everything else. When that fills up, we just close it up and shoot it down the trash airlock and put another one up there. Anything that's wet, we put in a bag right here. Now this bag right here is the urine bag. And we always keep one there. You can tell because it's got those things ... But essentially, we never put more than two urine bags in it, and then we try to put a few more other items in there like wet towels and the like. But they're always here. Any wet item goes in there, from the head, and any dry item then goes over there. So this means with - with three pieces of urine, you

We should have been putting those down all along, because he's been getting those sorts of photos every day, by a bunch. Inoperable equipment is the PLT's portable timer. It's setting on free wheels. He's going to take a look inside and see what - maybe give you a little more information on it. Unscheduled stowage item location change: two full urine sample bag racks from D-426 to the waste management compartment. One full half sample urine bag rack from the same place. Four peanut butters from 598 or 4 - excuse me, 548 to the wardroom. That's it.

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254 23 42 47 CC

Okay, Al; we copy that. Got a couple of questions here I'd like - like to ask you about. One of them I was trying to ask last night just as we were going over the hill, apparently. Back on Mission Day 40, we sent you a message telling you how to modify your WMC foot restraints so they would be - accept the shoes with the - triangle shoes, that is. We wondered if you did it, and if so, was it satisfactory?

Ref. 2.48

254 23 43 16 CDR

We did it to the wardroom one, and it's satisfactory; doesn't look too grand, but it seems to do the job. And we have not done it to any other items, just because we're just not doing it. That's all. We could do it.

A-62

CC

Well, okay, we're just trying find - You did it to - to all three sets in the wardroom; is that correct?

CDR

No, no. Jack didn't want his done. So he didn't do it. Let me look at Owen's. Owen doesn't use his, period, so his is - just mine. Apparently, Jack just did mine. He - He put them in and I just asked the guys if they wanted them or not.

CC

Okay. Very good. We copy that. Got a few questions on the stabilized binocs. You've mentioned about them getting out of focus. Is it the individual eyepiece diopter focusing

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

257 12 32 10	CC	Skylab, AOS Canaries and Madrid for 13 minutes. We'll be dumping the tape recorders at Madrid at 12:35. And, Jack, we need the DAS for dump inhibit.
	PLT	You got it, Story.
	CC	Okay.
	CC	Jack, the DAS is yours. We're seeing a good Nu_Z update. And could you verify that you closed the shutter manually?
	PLT	That's affirmative, Story; I closed it manually.
	CC	Thanks.
257 12 38 22	CDR	Story, just completed the water reservoir check, and they're all up.
	CC	Thanks.
	CC	Jack, 54 is in a double sequence; we'd like a STOP there. We saw the same problem yesterday.
	CC	And it's looking good now.
	PLT	Okay, thank you for ... that one.
	PLT	You there, Story?
	CC	Yes, sir, another minute and a half.
257 12 44 05	PLT	Okay, I received a message this morning, a general one about boots, shoes and that sort of thing, and I had reported that one of mine had torn out. And I think it was misunderstood that it was one of of the soft boots. The boot that tore out was my triangle shoe boot, and I been holding it together with tape. The other question was "does anybody use those stretch whatever you call them, for - in place of the triangles?" The answer is, "Al tried them and thought them to be not suitable." And I looked at them but didn't try

A-63

Ref. 2.50

		them and decided that the triangles would be a lot better. So we're not using those; we're using the triangles.
	CC	Okay.
	CDR	The reason they're not as good as the others, Story, is because they're not passive. You can go somewhere and hold yourself in, readily, as long as you keep your mind on it. But the minute you start concentrating on a pad, one of your shoes or the both of them come out and you float away. So it's - the triangles, if you once get them in, and they're adjusted right, you can then concentrate on the job and don't have to worry about holding your feet in place.
259 12 45 19	CC	Okay, thanks, Al. We're going LOS here. We'll see you over Carnarvon at 13:12.
257 13 12 40	CC	Skylab, this is Houston through Carnarvon and Honeysuckle for 14 minutes. Over.
	CDR	Okay, Bruce.
	CC	And Skylab, we would like you to stay off the DAS for a moment so that we may enable momentum dump, and also we'd like you to command the star tracker shutter closed again. It doesn't seem to have closed. The Nu_Z that you've got in is good. Over.
	CDR	Okay. Just went closed, and you're right, it's been stalled in AUTO.
257 13 14 55	CC	Skylab, this is Houston. The dump enable command has been sent. The DAS is yours. Out.
257 13 25 31	CC	Skylab, this is Houston, 1 minute and 20 seconds until LOS. Next station contact in 35 minutes through Merriott Island at 14:00 Z. Out.

END OF TAPE

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

267 11 30 24	CC	Skylab, this is Houston through Corpus Christi and Bermuda for 14-1/2 minutes. For the CDR, please.
	CDR	Go ahead, Bruce.
	CC	Roger. Wonder if you could give us an up-date on where you are in the Deactivation Checklist? Over.
	CDR	Okay. We're right on time. We're in the - well, right on time would be the answer. Everybody's cleaning up. Jack's run into a problem with his urine separator. It's not sucking air at the moment, but he's working on it. Owen is fixing his lunch. Not eating it, but just getting it ready. I'm over here in the command module. I'm a little bit ahead doing - getting ready to start the quiescent configuration check. Owen just finished taking the pictures of the Coolanol loop requested yesterday. If you'll shoot us up the pad, we'll take those vent pictures you wanted yesterday. And I've got the tools in my pocket. Sometime in the next 3 or 4 hours, I'll pull out some of those 82B kick plate screws and let you - You indicated you want a time line on them. So I'll pull out 10 and time it, and then that'll give you a clue how long it's going to take to get the rest.
267 11 31 34	CC	Okay. Mighty fine. And whenever you're ready, perferably this stateside pass, within the next 13 or 14 minutes, we'd like to get the G&N power up, page 2-4 and page 2-6 down to the bottom of the left-hand side, and then the E-memory dump on page 2-10. And we'll up-link you a - a clock sync, and we'll be pretty much in business. Over.
	CDR	Okay. I'll do that right now.
	CC	Beautiful.
	CDR	Okay. Now, do you want me to just give you a VERB 74 or do you want me to do the CMC self-check, IMU power up, optics power up, SCS power up, or what?

Ref. 2.51

A-64

GARRIOTT (CONT'D)	the amount of volume and work that it takes to fly extra film for the ATM I think that it would be the greatest mistake that we could make not to fly up the extra film required to give them a second exchange. I do have an exception to that. I would agree that the NRL A and B camera film package used are just too large to fly up a fifth exchange. But certainly for the S054 (doughnut containing the film and extra reel), certainly for the S056, film camera and very probably for the H-alpha for documentation purposes, we should have a fifth exchange of film. It'll be useful for looking at the Sun. In some cases, it'll be useful for looking at either X-ray sources or ultraviolet sources and it will also be useful for looking at the comet observations in December and January. I think this is the primary thing that we should be sure we include in the gear taken up on SL-4 - and if we don't it'll just be great tragedy.
BEAN	I don't know what Jerry's carrying on his mission. If he's carrying any extra clothes, he ought to offload them right now. The clothes necessity compared to getting new ATM film just isn't required. There are so many clothes to wear up there now. It's the same thing maybe for most of the other items with the exception of food. Time should be set aside where our crew went over the equipment that Jerry's planning to take up there and looked at it and said yes or no. For

Ref. 2.52

LOUSMA I think one of the things that makes all this a no comment is the fact that we had a good checklist. When we turned it on, it worked.

BEAN ATM foot restraint.

LOUSMA All we ever used were shoes, except for a couple of trials.

BEAN Here's the way I would do this if I had to do it again. I'd float in the workshop and, before I did anything else, get out my triangle shoes. I'd put them on and try putting them in the grids and adjusting them. Before Jerry goes, he needs to get a a 10-minute briefing on how to adjust those grids on his triangle shoes. Here's the way you do it. You tighten those things up as tight as you can get them all the little screws, and then you back, them off two turns each,. or something and that gets them all about the same - the three little screws. Then you put them in to where you can barely work them with your hands, your fingers, at that time, you're pretty doggone close. But then you always operate with the three screws. If they're too tight, you loosen each of them a quarter of a turn or something. You should practice that and that should be one of the first things he does. He floats down and he gets his triangle shoes on and he adjusts them just right, to whatever he thinks he likes.

Ref. 2.53

GARRIOTT I never adjusted mine the whole flight.

BEAN That explains a lot of things. (Laughter).

LOUSMA I took them like they were.

BEAN He couldn't find his shoes the whole time. Forgot where they were.

BEAN. I think you should launch with a rubberband they can put around their Activation Checklist. They should have a little string with the connector that connects your Activation Checklist to your pants. I lost more time in activation with losing that book than just about anything. It's because you can't do things with both hands and hold the book and keep it open to the right page all at the same time. At deactivation, I noticed that we all had our books clamped to us some way with a rubberband around them to the right page. Then we could do the job and the book was always trailing behind us and we could read it.

GARRIOTT That's the way Jack and I did it in training.

BEAN Is that how you guys did it? Thank's for telling me.

LOUSMA Another thing you need to do is to get a timer and a roll of gray tape and put them in your pocket.

LOUSMA I remember turning the ECS selector from PRIM to SECOND, back to PRIM, to check the the steam pressure read-out and so forth. During that period of time, I never had any indication of losing my attention span or ability to concentrate on a checklist or anything like that.

BEAN The only thing that drove me crazy was I was now pushing on this little button that is at the bottom of the counter-pressure garment, right in the middle of the back. That thing ought to be moved because I still have a sore spine from that. I suspect that you do, too.

Ref. 2.55

LOUSMA I do too. There's also a little matching snap on the coat that ought to be just cut off and cut that button out of the back of the hypertensive garment, so that it doesn't crush you so hard. I still have a bruise back there.

A-66

BEAN I think that the SL-4 crew's hypertensive garments are up there. So that when they get up there, put them in the command module, unbag them, they ought to cut out those two. It won't hurt the hypertensive garment a bit. When they put their jackets in there for entry, cut those things out and then it won't be a problem. It also hurt when you landed but mostly when you were entering.

LOUSMA It was apparently not in the cobra cable but was something common to all three crewmen.

BEAN Postlanding ECS: Ventilation was good. I don't think we had any symptoms of sea sickness. We were happy when we were in Stable II and happy when we were in Stable I. We did notice that there was a lot of sea out there and also that the frogmen were working pretty hard to hang on as they put on the flotation collar. Our procedure went well. It didn't take nearly as long as we thought it might to upright because of the heavy seas, and it uprighted in about 3 or 4 minutes.

LOUSMA No, it was probably a little longer than that. One other thing that you do notice you kind of wonder about at first, then realize it's okay, is that the windows fill up with water immediately. It looks like water is coming in the spacecraft but it's just seen through the windows.

BEAN Couch position: Nothing there. Physical comfort: The only physical comfort thing was this same old snap that was down there at the lower spine on the bottom of the pants. It was bumping into the lower part of the spinal column and that needs to be removed.

Ref. 2.56

Internal pressure: As Owen pointed out, when I punched in the circuit breaker to start the postlanding vent, it opened that

[redacted] There is getting quite a few empty lockers up there now for just throwing things. That's going to help Jerry. The food locker and dome lockers are getting emptied out.

[redacted] Also, we went through on the tape, channel A, before we came back and gave a complete readdown of every bit of food that was there. We went through an inventory of all our clothes and through an inventory as to what was in some of the big food lockers that were now empty so that Jerry would know where things are. And it seems to me that it would be advantageous to make up new stickers for those lockers so that he could come up there and stick them on the front and it would tell in nice neat letters what's in there now. And it would be much better than leaving the handwritten ones that we have on there now or in some cases, like in the wardroom where we've got some clothes of different people that are actually wrong. For example, it would say, SL-4 CDR clothes and really it's clothes that we had remaining and stuck in there when we swapped Jerry's out. It's quite easy to figure out what's in each compartment. We read it off and made a little list and went up there. It only takes you a few seconds to put the stickers on and then that way you can look at the stickers to see what you have. I'm much in favor of getting these stickers right. It helps you out a lot.

Ref. 2.57

A-67

BEAN (CONT'D) Clothes: Thought the clothes were adequate. We had more clothes than we needed as evidenced by the fact that we've left all sort of clothes up there that were our clothes. Particularly trousers and shirts. I wore Jack's T-shirts a lot because they were a little bit larger. Owen wore mine because he liked to wear more per day. The only thing that we all saw that was consistent was we all preferred to have more socks, but if we didn't, we probably could of stood it. None of us filled out our clothing form because we thought it would be more efficient just to give you a nice inventory at the end. You can take the number of days and divide by the clothes that we wore and find out what the usage rate is precisely. And so that is what was done and if the gentleman that was interested in clothes usage would check channel A, he could very simply determine exactly how many socks, pants and everything else we used.

LOUSMA The footwear - I never wore the soft boots at all. I always went around barefoot or with the triangle shoes. My triangle shoes ripped out. Everybody's triangle shoes wore on the back where the little Teflon insert along the heel and the Achilles tendon wore from the inside through. All the shoes have two holes in the back.

Ref. 2.58

BEAN This was about 2 inches up from the sole, right on the left side.

LOUSMA That's right, or either side of the center [illegible] from the sole. Mine wore and ripped out. The right boot ripped out along the lower right sole. The material just ripped where the boot is sewed to itself, down near the right sole. It was about a 4-inch gash that was wide open. You could see my foot through it. The only way around it was to bind it up with tape every day

SPEAKER The toes were through too, didn't they?

[illegible] put the toe caps on. That was required after about a week's use and in spite of the fact that the toe caps were on, the boots started fraying but it didn't cause any structural failures. The only structural failure was on the outside of the right boot at the bottom.

GARRIOTT I wore through my toe cap. I didn't install it correctly either. I took a shortcut on the installation and put the toe cap over the sole as well. I just gray taped it.

LOUSMA Gray tape.

GARRIOTT It lasted for 60 days.

LOUSMA We're not professionals.

BEAN Looked like a hocky player more than anything else. Gray tape over his toes.

Ref. 2.58

LOUSMA But it worked. You can't argue with success. Didn't affect his brain at all.

BEAN How about comments on the clothes, once again read 487, we went to so much detail on those clothes. They shouldn't take up any clothes. There's so many clothes up there. You can keep clothes for years up there.

LOUSMA I never wore any of those brown turtleneck T-shirts. I don't know what you guys found out about them but I had heard in the past that they didn't soak up the sweat very well or something.

GARRIOTT I don't know what you found. I didn't even wear it. I didn't like it, that's why I quit. I wore them for a while and found them to be just as good as the T-shirts. They don't feel as comfortable to me.

BEAN I don't think they're being used any.

LOUSMA I wound up doing what Al did with his clothes and that is taking the elastic inserts out of the sleeves and out of the

LOUSMA (CONT'D) legs to make it cooler. They were not required to keep your trousers from riding up or your sleeves from riding up. The clothes assumed their normal shape in zero-g just as they did in one-g and there was never any requirement to snap the tops to the bottoms.

BEAN That's right; that was it. In fact I don't think I ever snapped the tops to the bottoms.

GARRIOTT I was a little different. I took the knitted portion out of the trousers and left the knitted portion in all of the jackets and rather frequently I would snap the jackets to the trousers.

BEAN All the way around or just the back?

GARRIOTT No, there's just two snaps. One on each side.

LOUSMA Surprising to say that Owen did several things that were not required. And omitted several things that were. (Laughter)

BEAN How about inspections every morning? I never showed for inspections.

LOUSMA Why would a guy want to flunk inspections any more? That's why I didn't show up.

BEAN How about the crew quarters?

LOUSMA I think all that stuff is adequately discussed - on the important stuff. I don't think we ought to go through all of that. Must have gotten some outstanding comments.

BEAN Essentially the quarters were adequate to live in. There's parts that could be improved. Certainly the lighting should be improved in the quarters so that you could read a little bit better. The stowage provisions were adequate to hold whatever you had. It would have been nice to have some place a little bit larger to hang up your clothes that you wore during the day so that you wouldn't have to just leave them floating around at night. It worked out okay. Instead of putting my clothes in my compartment at night I hung them out there on the 131 control box.

Ref. 2.59

A-70

LOUSMA Trash airlock: Let me talk about the garbage disposal man. I want to introduce to you now, the super garbage man, Bean.

BEAN You got a two-phase garbage disposal. Generally, Jack put them in the metal can. He put them in the bags, I put the bars in the track airlock. We discussed the trash airlock previously here, and we've also discussed the fact that about the only place that is really dirty during this whole operation

LOUSMA Suit Donning: Suit donning is easier in zero g than it is in one g. The only thing that is more difficult is that it's tougher to get the outer zipper zipped around the back.

Ref. 2.60

GARRIOTT It helps to hook the donning hook before you try to zip it around the back. That will assist in bringing the two edges together.

BEAN Also, it helps if you get the guy to lean, and he must lean significantly harder since he doesn't have gravity helping him, at zero g as in one g. Also, the guy that's running the zipper can kind of pull the two parts of the zipper together before he zips it. He'll find that he can do it better also. It's easier once you get the hang of the fact that you're going to have to do a little more bending.

LOUSMA ALSA checklist: I thought the checklist did the job right. It was a good idea to do as much of the prep as possible the night before the EVA. The whole prep and post was much easier in zero g than it was in one g. The suited translation between the workshop and the airlock was no problem at all.

BEAN They should take a look at this defogging and see if it's possible to defog the night before, and if that would be acceptable. Then go ahead and defog the night before and put all

BEAN Sort of like a burned paint odor or burned insulation.

LOUSMA It's probably because you brought some things in there that were pretty hot.

Ref. 2.61

Moisture in the suits: I never noticed a whole lot of moisture in the suits, although we always went through the total suit drying procedure. The three little hangers that you hang your LCGs and PCSs on are already installed in the blue water tank ring, right above the suit donning station. You just hook up the suit dryer, and turn it on, and let it blow away; and be sure to keep the dome locker door to that suit dryer open so it doesn't overheat. We let our suits dry for 24 hours and then moved them up in to the MDA.

A-71

BEAN Some of those long, thin bologna like desiccants won't allow you to close the fecal drawer. If you don't have anything in the fecal dryer, and you close the door, that little black metal plate that the fecal would stand on sort of moves up, pressing near the top vent inside the drawer. Then, when the door closes, you will hear a slight vacuum sound, as the vacuum is pulled on the door, when you move the lever to the vacuum door position. Normally when you put the fecal in there, the same things happen, except of course, the little tray does not go completely to the top of the enclosure any more because the fecal bag is in the way. So it sort of tends

BEAN Same thing for the ones in the food compartment. I think they can live with them. I wish that the first time they corrected them, they would have made them big enough so that you could put both your triangle-shoed foot and your non-triangle-shoed foot in. We made an inflight modification only to mine because I was the only one that cared. The other two are not modified. It is certainly useable - not nice, but acceptable!

Digital multimeter: Good addition. We used it a lot. It's easy to read. It has good batteries. I would suggest that you keep it off between uses. It's a good addition to the toolkit and we probably should have had it initially in the toolkit.

LOUSMA The only problem is that, when you take the little pins out of the probes, there is no place to put them. The little screwdriver that goes with it floats around. It's going to get lost one of these days. You have to tape it down. There is no good place to put it.

Ref. 2.63

Shoe repair kit (toe): It seemed to do the job. It protected the toes anyway. It is a little bit difficult to line up the holes and get the screws back in, but after working at it awhile, you can do it.

GARRIOTT Inflight Oral Hygiene: I had no mouth discomforts. The brushing frequence of sorts was only once a day. I never used any toothpaste the whole time I was in orbit. We weren't supposed to swallow it.

BEAN No baths and no toothpaste!

GARRIOTT I never wanted to go to the trouble of finding some empty bag to go spit it into. So, I just brushed my teeth with water and a toothbrush and apparently that was satisfactory based upon the reports coming back from our good friend Dr. Bill Frome.

A-72

Dental Floss: I used three or four times as required when I thought I had some food caught between a couple of teeth. I thought the toothbrush was adequate and was appropriate for massage of the gums, which is essentially the main purpose of brushing, anyway, and particularly the way I was using it.

Ref. 2.64

Sunglasses; other Eye Protecting Devices: I never took them out of their pocket. I didn't need them. I never had any problem without the sunglasses in regard to visibility of instruments and controls. No unexpected visual phenomena relating to the eye such as focusing or double vision. I never noticed any change from preflight to spaceflight

SIGMA I had a split lip that I got about 10 days prior to entry. I kept putting stuff on there and it kept cracking and bleeding all the time. It never did get well; I should have used it.

BEAN My fingers got in awful bad shape. I had hang nails, they dried out and cracked. I started using Alpha Keri lotion but it was too late. I believe if you applied it daily particularly to your hands and maybe some on your lips just before you go to bed then you could keep from getting behind the curve. Once your skin dries out, it then appears to take a long time to recover. That ought to be part of your daily personal hygeine routine. I had a swelling under my arm a couple of times, a little node. I don't know why I had it. I assumed may be the deodorant so I quit using it. That didn't seem to help it because a second one came. I started wearing a looser shirt, Jack's undershirts instead of my own. That felt better but it didn't seem to help it. I not sure it just wasn't the environment up there. Perhaps the chemical content of the food. Actually it was very healthy up there. We had a total of 180-mandays and nobody had a cold, nobody had diarrhea, nobody had anything to speak of. It's healthy up there if you can keep your eating sleeping habits correct.

Ref. 2.65

BEAN Yes, I tried it a couple of times using a cloth, and found that it didn't clean it as well as I had hoped. I did notice that many things not visible to the naked eye, such as hair, came off on the cloth. Judging from the amount of grime and grit that I got off of it, it probably collects germs. It should be washed with soap and towels with nap about every 2 weeks.

GARRIOTT Why not just put in a replaceable cloth screen that can be peeled off rather than cleaned? It would save time.

BEAN That would be good for a future design. Meantime, S1-4 should wash it to ensure cleaniness and to increase the airflow.

A-73

QUERY Let's talk about the donnings. Did you don footwear in the morning and wear it all day long, or did you change footwear according to tasks as the day progressed?

Ref. 2.66

LOUSMA I put on the triangles when I first got up and left them on all day.

QUERY Jack, you mentioned at one point during the clothing debriefing that you had torn out a pocket on a pair of trousers. Was it that way when you got it out of the stowage, or did you rip it out somehow?

LOUSMA I think I ripped it out, but it had a weakness to begin with. One edge of the left hip pocket, where you put the checklist book, came loose.

QUERY Did you just wear that particular pair of trousers and put up with it until the next sequential changeout?

LOUSMA Yes. I lost the book a few times.

QUERY Owen, you mentioned that you were going to cut out the cuffs around the bottom of the pants to help with donning and doffing over the triangles. Did you do that?

GARRIOTT Yes, and it was an improvement. The cuffs were there in case it got chilly and to keep the trousers from floating up in zero g. However, the trousers stayed fully extended down the legs. Al routinely cut the cuffs off.

BEAN Yes. Although many things in the space station operation are optimized to an unnecessary degree, the clothes are not. They are probably one of the best tools you have all day. You need the pocket just the right length and width to accomodate such items as pencils and books. The clothes for Shuttle should be designed precisely with day-to-day operations in mind. An ordinary pair of coveralls will not do. Let me give you some examples.

BEAN (CONT'D) We all wanted our scissors. Those scissors pockets were terrible. The flap didn't overlap enough, and they [illegible] had a little piece of velcro on it. Same thing with the knife pocket. Those things are important and they allow you to do the job day after day so much faster and smoothly if you have everything where you can grip it. So the Shuttle crews should have their clothes designed to suit their particular needs. They should consider what they're going to use each pocket for. That became critical as far as where the tape and your timer were. All those things should be developed first, then the clothes can be designed. They don't have to be custom made. If we had done a better job on the clothes, we could have worked faster on a day-by-day basis.

A-74

GARRIOTT There's no reason why the shorts, socks, and T-shirts couldn't have come right off the shelf.

BEAN Exactly.

GARRIOTT The other thing I wanted to mention was the brown material for the shirts. None of us could wear it. Al wore it a few times. We just wore the white T-shirts or the jackets. You can't put up with that brown shirt against your skin.

Ref. 2.66

QUERY Would you fundamentally change the array of clothes that we have now or would you start with what we have now and modify them?

BEAN I'd get rid of the shirt use the undershirt as the shirt. I'd eliminate some of the extras on the clothes, like the comm that we never used. If you did have to use comm, you could clip it on to the clothes somewhere. Make sure that the comm has little clips. I'd get rid of the little booties. Nobody uses them, and they don't seem to have a function. I'd get rid of those gloves, maybe.

LOUSMA There was a lot of discussion preflight about one piece versus two, and I think two is good because it gives you the flexibility to stay at whatever temperature you want.

BEAN The convertible long/short pants were good.

QUERY Al, were you talking about the gloves in the clothing module?

BEAN Yes, flight gloves.

QUERY Jack, if you just used the triangles all day, what did you do when you went to the head? There are no restraints in there for the triangles.

LOUSMA That's right. I just floated around. That was our complaint.

GARRIOTT You can tuck them in that slot above the urine drawer or behind the urine drawer, if you want to. You can use them or not use them, it doesn't make any difference.

BEAN But you weren't going to bother taking off your shoes. It was easier to float around and be uncomfortable than to bother taking your shoes off.

LOUSMA Those foot-strap restraints in there were unacceptable for triangle operations. You really had to concentrate on holding your feet down or they would flip out.

BEAN I still think low-top triangles would have been useful all day long, except for use on the bike. It was hot wearing those high-top tennis shoes.

GARRIOTT Two months in one pair of shoes was also inadequate because we wore them on the ergometer and you sweat a little. They did rip out, a time or two. One pair of shoes for all of the functions was inadquate.

BEAN I would prefer to have a set of low tops to wear all day with my triangles. Then when you got ready to bike, you set those aside, put on your tennis shoes, then put the others back on after biking.

GARRIOTT You had to change shoes anyway because you were in the LBNP, so it's not an extra shoe change.

BEAN But that may not apply to Shuttle.

QUERY If those shirts were cotton Owen, do you think you would have worn them?

GARRIOTT If they were just like the white cotton T-shirts in terms of material, yes.

LOUSMA But I didn't like the tight fit. They fit too close all over. It doesn't feel nice and loose like a T-shirt, or like the shirt you got on now.

BEAN We had more clothes than we needed.

GARRIOTT Except for socks.

BEAN We all needed a few more socks.

LOUSMA We need a clean pair of shrts and a clean pair of socks every day.

BEAN I think a jacket would last a month and a pair of pants would last from 1 to 2 weeks.

QUERY Was there any particular activity that may have helped wear out the heel portion of the shoe?

LOUSMA I think they wore out from the inside. There's a little Teflon rib that goes back on the inside. Just from the normal flexure, it wore out from the inside, because we all had the same two holes on the backs of both shoes.

QUERY What about the ergometer? Was that where it got its hardest wear?

LOUSMA Yes, they probably did, but I don't think they were wearing out against anything. They wore out on the little rib inside.

QUERY Did you have any general difficulty in donning and doffing clothing? Did you want to be contained, for example, in the sleep compartment or did it make any difference at all?

GARRIOTT I preferred to float.

BEAN You didn't have any place to put them at night, so you stuck them on the walls.

GARRIOTT I always stuck mine behind the comm box on the cables.

QUERY Did you develp any particular individual technique for handling cargo items that you had to transfer from place to place? Jack, you carried things between your feet sometimes. Was there a size limitation on how you could do that?

LOUSMA Something approximately the size of the tape recorder, for example, was convenient to carry between your legs. I frequently tucked the checklist between my knees but that was just a little small. Things like the food lockers are too big. You have to be careful to control of your rates so that heavy things don't slip out and hit something.

GARRIOTT If you're careful not to put too much energy into anything that you're moving, there is no limit to what you can move around and position. The 3-ton film vault would have been a nice demonstration of how easily large-mass items can be handled.

LOUSMA I carried things inside my shirt many times, especially books, checklists, and small things.

QUERY Did you run into anything at all that you felt was a two-man transfer task, or could you handle everything individually?

LOUSMA It was the other way around. The things we thought we should have two men on, we used one man.

BEAN The only time we used two men to advantage was when we were doing things like transferring the film out of the flim locker to the command module. One guy read the book and checked them off and the other guy took the film.

PLT — I think the fact that they were toggles, like switches, instead of the old kind of circuit breakers was really what made the difference. They were easy to flip, inadvertantly. Anytime you grab the little ---- in fact, anytime you grab one of those little switch guard covers, use it as a handhold, it was very easy to trip a switch or a circuit breaker.

CDR — Tripped a master alarm one time, grabbing the guard.

SPEAKER — Did you have any electrical discharges occur during any activities or equipment operation?

SPEAKER — Yeah, they covered that this morning, I forgot to mention it. But let me ask.

CDR — With close, only. As far as I know.

SPEAKER — We probably spent a lot of money grounding everything, except those ----- just because of the nature of it, we really didn't go overboard on that. But did we probably overdo that? The impression I got this morning, was, somebody, Owen thought on one occasion he developed some static electricity, but other than that there was nothing.

A-77

PLT — I didn't notice any at all.

CDR — When I took off my clothes, sometimes I could get a little static electricity on the arms, you know, but none, nothing ever visible and you're right. We shouldn't do, bother doing that unless there's a need for it. I don't know how you do in airplanes, but I'd say about the same as in airplanes. Never had any problem, and probably spent millions doing it. Got to cut the cost of this thing.

Ref. 2.67

SPEAKER — Maybe the reason you didn't have any trouble was because you had everything well grounded.

SPEAKER — Yeah, I think thats true with respect to basic structure and everything, but all the add-on items-- Most of them just didn't lend themselves to it.

SPEAKER — Went through a considerable program to make sure you had grounding straps, and when things were withdrawn, they were grounded until they came apart and things of that nature. I would be hesitant to eliminate grounding just because you didn't have any trouble with it.

SPT: — Not very clearly. I remember when they changed the thermostat and I remember being a little chilly several mornings when I'd roll out at near zero beta. After running around taking our body mass for example. You can't get dressed, you have to stay in your underwear or whatever you've been sleeping in. For about ten or fifteen minutes there while you're running around trying to get breakfast and get yourself awake and all that, you can be a little chilly but it wasn't bad.

Ref. 2.68

PLT: — I think generally we preferred it on that end of the spectrum.

SPEAKER: — We noted that, we've got four ceiling temperature measurements that we averaged to try to come up with an average environmental temperature inside. You know when you put that ambient temperature probe and you gave us some readings by voice. Those readings in general tended to be about a degree and a half lower than what we were averaging last week. We've got no way of knowing which one was more accurate. There was that difference. The ECS ducts gave some concern before the mission because they are made out of that flexible material and they tend to sag. At least they did prior to flight in some cases there and we wondered whether or not you noticed any deformation or anything that could affect the flow reduction because of the sagging of that duct material?

SPT: — The three large ducts?

SPEAKER. — Right.

PLT: — I think they are all fully extended at all times. It looked like they were maintaining their shape.

SPEAKER You mentioned about the dryness and chapped lips, cracked lips and so forth. Now, do you know after the second EVA that TCCS, you know, stuck. It, where the main control valve in the airlock system normally controls to --- degrees. Its what controls your dew point inside and its stuck at forty two, which tended to lower the dew point, you know in the spacecraft. But I was wondering could you tell any noticeable difference, did most dryness occur after that happened or was it just ------.

SPT I noticed no difference.

PLT I didn't either. We thought it was dry at the beginning and that we might get use to it, but I don't think we ever really did and maybe that's the reason, because the dew point did change in there. Maybe we would have gotten use to the higher alright.

SPT Did you know the dew point went down?

PLT No, I didn't know. At least I dont remember. It may have come up and went over my head.

SPEAKER The average dew point was running somewher around 51° or so prior to that sticking of valve in there. After the valve stuck it was more like an average of 46°. So it was a fair decrease in dew point.

Ref. 2.70

PLT I think we generally preferred it on the dry side as opposed to the humid side though because it sure was comfortable to exercise and not be sweating for a long period of time and every thing dried out quite readily. Rags or anything you had hanging out dried and if you got your clothes all sweaty why they'd dry in a hurry. If you splattered water around it would evaporate quite quickly also. I think I preferred it on the dry side ------.

SPT While we were up there we wished that it was more humid. I mean not like Houston weather. But above the dew point that we had. But these are all advantages and had we had it at say 60° or something instead of say 41° or 50° we might have decided that the other disadvantages were not -- were worse than the advantages we had for it, so we might have preferred to go back. Although I do remember talking inflight about wishing it were a bit more humid. Don't you remember discussing that?

A-78

PLT I think I did. But later on in debriefing to 487 I think I concluded about the same that it would be better to be in the dry end.

tape recorder and the removal of several cards from inside the recorder, tightening of the chain linkage on the experiment S019 articulated mirror system, repair of an ergometer pedal, and electrical continuity tests of cables which were exhibiting an intermittent condition.

The tools used to perform these maintenance tasks were, for the most part, satisfactory for accomplishing the task; however, some of the specialized tools did not work as well as standard off-the-shelf tools. For example, the socket-type tools fit very loosely. Some of the maintenance tasks were not foreseen and, thus, specialized tools were not available. In these instances, either an available tool was used or a tool was improvised to solve the problem. Not only should specialized tools be supplied in future designs, but standard tools such as one might have on his home tool bench should also be provided. This visit showed that, in general, given the proper tools, any maintenance task that can be performed on the ground can also be performed in space. In performing maintenance tasks in zero-g, a method for containing and retaining tools and removed parts must be provided. A solution would be a central work bench area where the various components could be taken for maintenance, with tool and component retention capability and good lighting.

10.2.9 Clothing and Footwear

Used clothing items were discarded when soiled, since no onboard laundry facilities existed. Enough clothing was provided to change socks, T-shirts, and shorts approximately every other day. The crew preference would have been to provide enough clean socks and shorts to change each day. The brown durette turtleneck shirts were not used because they did not absorb perspiration well, and they fitted more tightly, and were warmer than the white T-shirts.

Trousers were provided on the basis of approximately one change per week, and this was more than adequate. The trousers had three pouch-type pockets and one flush pocket. The pouch-type pockets were used mostly [illegible] contain more items. The flap on the scissors pocket [illegible] so short that the scissors were continually [illegible]

[illegible]

Ref. 2.72

legs would not ride up on the body in zero-g. This visit showed that elastic cuffs are unnecessary, as the clothing did not ride up when the cuffs were removed to provide better ventilation. Whether the snaps for connecting the trousers with the jacket were used or not used seemed to make no difference. However, the snaps on the back of the clothing made an uncomfortable pressure point on the spine during entry and should have been removed.

Two types of footwear were provided: soft boots, much like house slippers, and triangle shoes. The boots were seldom or never used, and the triangle shoes were used almost exclusively. The triangle shoes were made of heavy canvas and had a toe cap which prevented fraying and excessive wear. Each shoe developed a pair of holes above the heel as a result of an insert which wore through from the inside. One boot developed a 10-centimeter tear parallel to the sole from loads exerted while pedaling the ergometer. Overall, the triangle shoes were comfortable and the better of the two designs.

10.3 COMMAND AND SERVICE MODULE SYSTEMS

The command and service module systems performed satisfactorily with the exception of the problems with the reaction control system quads B and D discussed in section 7.7 and the coolant leak discussed in section 7.8.

The fundamental lesson relearned from this flight is the need to communicate information about unusual systems behavior as soon as the condition is noted by either the crew or ground personnel. Examples of this were: fireflys visible out of the right-hand window [illegible]

324 00 02 27 SPT The SPT, 00:02, talking on medical observations. And this should go over to Jerry Hordinsky, the medical director. We all have noticed - too much since we got here - a dryness of the skin and certainly in the mouth. And a good part of the dryness that we feel in the mouth is from the medications which we've taken. We noticed that on the ground, but, apparently, this atmosphere up here really enhances that. One interesting thing I've noticed in the effect of zero g - Well, it's really an effect of body orientation on the room you happen to be entering - that I can move into a given room sideways or upside down and not recognize it, or I would recognize it, but I would not feel at home in it.

324 00 03 24 SPT But as soon as my body would rotate to the one-g attitude, that's the attitude which I had in working with - in the trainer for well over a year now, then all of a sudden my mind would flash and say, "Yes, I know where I am," but until that time, why it would look like something entirely different that what I had been working in. It's as though your mind won't recognize the - the situation you're in until it sees it pretty much in the old standard way. And as soon as you get pretty close to the right orientation, then all of a sudden, zap, you get these - transformation made in your mind that tells you exactly where you are.

324 00 04 23 SPT I noticed this effect especially in traveling from up in the MDA through the OWS forward area and then finally coming down into the experiment compartment on the lower deck. When I come in there, everything looks sideways. And not until I rotate and put myself in the same attitude as I do in the one-g trainer, do I really recognize and feel familiar.

324 00 04 49 SPT The lack of one-g has some odd effects; for example, we've noticed it's very hard to tie your shoes. You usually use one-g, believe it or not, to pull yourself down.

Ref. 3.3

324 00 05 06 SPT One thing I'm trying to do is to keep the calves in shape. And two things there: Just move the

triangles to the very tips of the shoes so that I have to use my calves more and whenever I'm anchoring my feet in; and, also, I'm not tying the top two laces on the shoe so that I don't get the extra ankle support from them.

324 00 05 27 SPT SPT out.

TIME SKIP

324 01 42 43 PLT The PLT reporting on T003-234 housekeeping. The readings were station 6 - filter position 6: channel 1, 80; channel 2, 4; channel 3, 3.

324 01 43 08 PLT Filter position 6, after: channel, 114; 2, 15; and 3, 14.

TIME SKIP

324 02 23 49 PLT PLT with the Coolanol postservicing BMMD readings: 5.36892, 5.36907, 5.36884, 5.36960, 5.36876.

324 02 24 09 PLT PLT out.

TIME SKIP

324 04 33 11 PLT PLT, T00 - T003. Position 2: channel 1, 318; channel 2, 9; channel 3, 9; time line, day 324:04:20. T003-3, 324:04:25: channel 1 with 159, channel 2 equal 2, channel 3 equal 2. Filter position 4, day 324:04:30 hours: channel 1, 212; channel 2, 11; channel 3, 3.

324 04 33 55 PLT Say again channel 2, 11; channel 3, 3.

TIME SKIP

324 12 25 36 SPT SPT at 12:25, M133 log. Day of the year, 324; length of sleep, 7.0; quality, fair.

332 17 40 34 PLT

One thing that we've noticed is that we may be running out of tissues, and because of the combination of 5-psi environment and zero gravity, we have - I have a continual problem with nasal congestion. And it may be something that is - Before I forget it, it would be nice to include in all future stowage areas - Put in tissues. I think we're probably okay, but we're going to run pretty tight.

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332 17 41 13 PLT

Ref. 3.5

Okay, on the triangle shoes. I've not been able to use the mushroom shoes; I'm not reporting on them. The triangle shoes really take a beating. This has been reported by all crews, and I think it's, of course, that we've use - When you move around, you tend to sort of move with your hands and try to stabilize and stop your thrashing about with your feet. The shoes really take a beating, the backs and the toes. The fireman's pole's excellent. I - I use that all the time.

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332 17 42 46 PLT

A-81

Okay, I think I've already covered item number 2 in my discussion of temporary stowage provision and small restraint. As far as body restraint, triangle shoes are excellent. I have found myself at times when there's no grid pattern - Like when I did the Coolanol servicing maintenance task, I actually took tethers, tethered my ankles to handholds on the mol sieve. Because as you maneuver with your hands, the rest of your body torques about. And you've got to have some - some way of restraining your feet because this is the one part of your body that - over which you do not have as much control as, of course, the arms and the upper body. As far as recommendation - as recommendations for improvement, I would say that the triangle shoes are very good, a little bit difficult to get in. If it could be made easier, that would be an improvement. The only way I can think of improving it is, where you don't have the permanently installed grid, that you should have some way of attaching, say, something like a fishnet webbing or something into which you could put your feet to restrict - restrain the lower part of the body while you torque about with the - with the upper body and the arms. If you had something like a fishnet that you could stretch around - and I'm talking about one you can just poke your feet through and maybe entangle them in a couple

another streamer that almost bisects the two, which, my guess, probably comes from - I guess, probably prominence 31 or filament 35.

333 23 27 42 CDR — Again there doesn't seem to be any significant change in the white light coronagraph since the last pass. Dialing up the XUV again and looking at it with integration, the bright area that I've been talking about at 320.3 is not yet bright enough to manifest itself in the ambient, that is, without integration. As I look at the XUV MONITOR now, I can see active region 87, 91, 92, and 84 without any problem at all. The bright spot over there that I was talking about is not really discernible until you hit the INTEGRATE switch. At that time, you pick up that bright spot plus another bright spot on the limb which, according to the SAP, I believe, you called active region 76 coming back over the limb. And that's about it.

333 23 28 53 CDR — As I turn down the brightness on the H-alpha, I can see that active region 91 is still - correction, 92 is still the hottest one of the bunch. However, 91 is now giving it a good run for its money. 91 has one rather bright little area in it and active region 87 seems to be picking up some, too. They're getting much more closely to the same intensity at this time. That's about it for now.

A-82

333 23 29 31 CDR — CDR out.

333 23 44 38 PLT — (Music) PLT on the M171-1; the subject is the SPT. PERCENT O_2, 71.83; PERCENT H_2O, 4.06; PERCENT CO_2, 2.04.

333 23 51 41 PLT — (Music) PLT with an M487 update for people that are interested in restraints. Time is coming up 23:55 Zulu. I just thought of a couple of items that may be of interest. One is triangle shoes. Although they are very useful, this isn't - doesn't mean they cannot be improved. And one of the problems that we have with them is getting them off. It takes an awful long time to get them off and get them on; it's awkward. I don't think the lacings that we have on these shoes is the answer. It's awfully time consuming taking them off and putting them back on, and we have to do this several times a day

Ref. 3.7

because of medical experiments or one thing or the other. Working out, when you clean up, at random - probably putting our shoes on and taking them off - probably four to five times a day. And the lacing gets to be an irritation. And it's time consuming.

33[illegible] 23 52 37 PLT — Another point on triangle shoes, of course, is wear, that you've already heard about. The toe caps have been installed on the CDR's and the PLT's. They seem to be working okay, but we're also chafing the heels of these things, and I don't know why, but the back - up the back of the shoe. Third point is that the triangle slips along the groove, and I think - any - if we go this way in the future, one of the things that would be very useful would be to have some kind of toothed or toothed track which would hold - tend to hold the thing firmly to keep it from slide fore and aft, and then the - the little wingnut that we use would not have to bear the full brunt of the stress that's given to the - the triangle cleat part when you move around. You can tighten it as tight as you can with the channel-lock pliers, and in about a day, they're loose again. So, there needs to be a - a better method of keeping the triangle from moving.

333 23 53 40 PLT — Second unrelated point, but still I - in the way of restraints, is that - again the drawers and the poor design of the drawers that we have. In the food compartment, the pudding drawer is completely inadequate. The puddings are always floating out of their restraints and getting upended when you pull the tray out to put on top of the food preparation table or the trays to heat food. The puddings all come floating out. The tray is required to restrain the puddings in the tray there - that is reserved for pudding.

333 23 54 16 PLT — Another point is - I mentioned yesterday in the M487 about the difficulty in restraining the pieces of paper - managing the pieces of paper. One of the things that we - we found that would be - of course, clips are very nice, but once they're off of the counter bungees, it's very useful. However, when you're using the bungee, you almost have to have a convex curved surface, so that the bun - bungee or rubber band or what-

338 03 35 05 SPT

Going back to seasoning dispensers, I've not used them too much at all. I guess I'd give them an adequate, the problem being that many times the seasoning leaks out of it, and it will also run up the side of the dispenser when you try to get a drop out. Eating utensils: I'd give those inadequate; the main reason being there that the ser - spoon is way too small. I've had to use one from the command module. Sleep restraints: I'd give that an adequate. One of the problems is that it's kind of tough to get in and out of that thing. It's a real struggle every time I work at it. I also don't know what the heck that thing hanging over my head is supposed to do. I would much rather have something you could pull from one side to the other. The thing hanging over my head just really gets in the way, and I'm thinking of cutting it off.

338 03 36 07 SPT

Ref. 3.8

Trash airlock - Okay, sleep restrairt I give an adequate. Trash airlock: Commander does all the work there. From what I see, it looks - looks very good except for the possibility of binding up on you. Vacuum cleaner: I'd give that an adequate. The problem there is that it just doesn't have enough suction. Wardroom table, nonEating area: I find putting the cover back on after every meal is just too much thrashing around, so I never really do it. For that reason I give inadequate - gave it inadequate. Tool caddy: I'd give it a poor just from the general concept - maybe if I ever have the occasion to use more than four or five tools, I'll go ahead and use it, but I find it just as easy now to tuck the tools in my pocket and go. Portable fan: I give that an excellent. It works real well. We've got it sitting over there by the bike; it cools us off real well. ODAE kit.

A-83

338 03 37 19 SPT

What the heck is an ODAE kit? I give that a question mark. Garments: I give those an adequate. Problem there is that I just get tired of this darn brown. I would like to see some fire restrictions such that we could get some good-looking clothing in here. Other than that, I find most of the stuff fairly useful; some of the pockets are a little bit too small for what you want to put them in - put in them, especially around the back.

It puts the ground into a full-scale panic to even touch those things. So I guess I'd say that poor to adequate would be the rating I would give the handrails. And as far as the MDA and WCS as a working area, as far as restraints are concerned, I'd say it's unacceptable. Gross shortcomings all over the place, and the MDA is just a lousy place to work.

344 21 41 22 PLT

Ref. 3.13

Triangular shoe cleats/grid: I would say very good to excellent. Conical shoe cleats/grid: I've not used yet. I want to get around to using those; I'm going to try to fit up my second pair of shoes with conical cleats and try them out. Water tank foot platform is excellent for working dome lockers. It's no - not much good for working water tanks. I'd say it's poor for working water tanks because of the crouching action that has to take place. By the way, a crouching action is very difficult in zero g; so if you design a foot restraint where there's - this posture requires a crouching action, then you're not helping us at all. In fact, it's a great hindrance to have to go into a crouch because you have to hold your abdomen very stiff and your leg muscles very stiff and you're at a constraint strain even putting on shoes. When you bend down to put on your shoes, if you bend down, it's difficult; if you pull one leg up at a time, it's not too bad to lace shoes.

344 21 42 22 PLT

Portable M212/479 foot platform: Not applicable except for its EREP proposes. So - And that's very good except it's very limited. It's only good for the C&D panel, and that's about it. The rest of the thrashing about for the C&D and the VTS operator is done without foot restraints and is difficult. The ATM foot platform is good. Portable PGA foot restraints: I didn't get to use them my last time because I was - I had to use my PGA foot restraints for the EVA - foot restraints for the S193 maintenance. Portable handholds: Not used. Portable equipment restraints - tethers, bungees, universal mounts, et cetera: Tethers and bungee, in general, are - are - are very nice to use; however, the ones with the little, line wire hooks on them are really bad. They - The wire comes out from under the rivets, and you've just lost it. And not only that, but when that happens, you've got a nice wire fishhook there thrashing

344 22 01 17 PLT

Wardroom table, non-eating uses: Well, we find ourselves not putting the top on the food trays a lot. It certainly would - it - it makes a nice working surface. I would say it was adequate. Tool caddy: Oh, that's - that is unacceptable, the tool caddy is. I used it one time, lost two or three tools, and I don't know what all else, and I threw it away. I threw it back where I got it and vowed I'd never use it again.

344 22 01 42 PLT

It does not hold the items, and it's got all the little pickiest pockets on it and everything and I think I could - I - I - I don't want to be unduly critical on it because I'm sure that someone had our best interests in mind when they designed it, but that thing is unacceptable for all because it doesn't serve the purpose for which it is designed. Portable fan: We have - there's - there's certainly - Let me give it a very good. They certainly move air, and they seem to be a lot bigger than they would really need to be, but from that standpoint, and from the functional standpoint, they're ex - ex - Let's see. I gave them a very good. Okay. ODA kit: I don't know what that is.

Ref. 3.14

344 22 02 25 PLT

Garments: Garments should not be made of the synthetic material if you plan to wear garments for more than just a little while. Cotton is very nice next to the skin. The - Whatever this - PBI, or whatever it is we wear, it's very odorous - odoriferous. It stinks, is what it does after a couple of days' use. And if you looked at our consumables, you can - you know what we do not have a change of clothes every day.

A-84

344 22 02 56 PLT

So that this - Whatever this brown - dirty brown stuff is that we wear, it certainly is not good for repeated wear. Other than that, I think we were high on the learning curve, and I just cannot criticize people for selecting this fabric. We just didn't know. But just to make - make it clear, so that there won't be any failure in communication, I would say that the clothing is poor to unacceptable because of the fabric and its odor and its poor perspiration-absorbing qualities.

344 22 03 31 PLT

Also, the - Again, I don't know. I don't want to be mean about this, but the little pockets that

we have on here, the scissors keep coming out of mi***. They weren't quite large enough for the scissors. I don't know how. The little flaps were just not long enough on a lot of them. If the flaps had been about an inch and a half longer, we could have used the little - tiny little pockets, and I'm talking about the one in the front. I've used - I use it for pencils now. It would sure be nice for a penlight, but it's just no good because the little flap isn't long enough. The snaps on the clothes, that one in the center - These clothes were inci - apparently were not designed by a clothes designer because - Put a snap on the back of it, it rests right on your spine when - Of course in one g, it's very bad. In zero g, it's no problem. But we use it a lot in training. In one g, that thing was really bad.

344 22 04 24 PLT

So overall - let's see - overall, I give garments an - an adequate rating with the qualification - the comments that I've made, again understanding that those were - those were made in the - on the basis of experience that we have gained as in actual use and not because there was - there was any failure on the part of people to anticipate, because we just didn't know. Light baffles: Now, I don't know. At least that's in the sleep compartment. I have no question about the light baffle. I have no problem with that.

344 22 04 54 PLT

Privacy curtain: I've no problem with that. That's certainly, say - Give it very adequate to very good on the light baffle and privacy curtain. Air diffusers: They're - I would say there's - they're completely adequate. And I - I know we have not gone around screwing them in and out or anything like that because apparently we're getting enough flow and it - it doesn't bother us that much. Air vents in the sleep compartment: I've adjusted mine several times and they're excellent. I have no question about those. And that ends the debriefing on 3 Alfa for the PLT, pages 3-3 and 3-4 in the mal checklist.

344 22 05 39 PLT

PLT out.

344 22 15 19 CDR

This is the CDR at 22:15 Zulu with a 487-3 Alfa, a subjective evaluation guide, number 1. And we'll just get right - right off with the top one

turn the spoon over and smear it over the top of my food and it seems to be - it's evening out quite nicely. The eating utensils: The big spoon is by far the most handy. The fork is used only when we have meat - frozen meat, and it doesn't get much use other than that. The small spoon, in my case, gets very little use. So let me go back. I have - I've broken away from the grading system again.

344 22 42 02 CDR

Food cans. I - I've - I gave them a grade of - Let's see. I think I gave them a grade of adequate, and it would have been better except for the danger of it, the sharpness of the thing. The beverage dispensers also are adequate. Seasoning dispensers are adequate. We need to - need some improvements. Eating utensils, I would say, are very good. I think we could probably leave the little spoon home. I could move in - move on to miscellaneous now. We have sleep restraints. I would grade the sleep restraints as very good. At - Having had to sleep in the command module with no sleep restraint and then getting the next night down here in the workshop in the sleep restraint, I must say that the difference was quite - quite - quite sharp.

A-85

344 22 43 04 CDR

It was a very strong difference; it was very - it was very pleasant to get into that sleep restraint. I think the best thing we ever did was make those body straps. I think that they've been very fine. I think maybe that in the future, that we don't need to go quite to the extremes of having to get in through a neck ring. I think it would be just as easy to have a sleeping bag sort of thing. If you could zip down and get into it and then zip up, then you wouldn't have to climb into it through a neck ring.

344 22 43 47 CDR

Ref. 3.15

I think the flexibility that's been designed into the restraint is very good. The fact that we can have a - either no blanket or a top blanket or a top and bottom blanket is very good. At the present, I have never used a - an overblanket, the top - the bottom blanket. The top blanket has - was on when I got here, and I've kept it on. And the only times that - When I've gotten cold, I found it to be much more convenient to put on a pair of - a half union suit than it would be to put on the lower blanket. And so when

the beta angle gets lower and we start getting cooler, I just put on a half union suit. That keeps my feet warm and the rest of my body stays quite warm.

344 22 44 38 CDR

In the very hot weather, I leave the top blanket rolled up and put it under my head rest, and I sleep in the nude. And I found - find it to be quite comfortable. So I found essentially that I've had no use for the - the large overblanket, the bottom blanket I've been calling it, and that I find that by just either rolling up or leaving the top blanket down and changing what I sleep in, the clothing I sleep in, that I'm quite - quite comfortable in the sleep restraint. I think the head restraint has been a good idea. I've made quite a - quite a use of that, and it helps quite a bit.

344 22 45 25 CDR

The trash airlock: The trash airlock has been very good. I think I would give it a rating of - I'd give it a rating of very good. Works quite well. Thank heavens we made the - the pressure relief valve, the orifices, large enough so that you don't have to wait an unnecessary long period of time while that airlock either vents or pressurizes. The trash airlock is pretty straightforward, works quite well. We've not had any problem with it so far. We took the advice of the SL-3 crew, and that was: "Be careful. Do not fill your bags too full so that they cause any trouble getting out."

344 22 46 14 CDR

The three little tabs on the bottom of the bags that fasten over the dogs, the ears on the trash airlock, I think were a very good idea. It gives you an opportunity to get a good thrust going with the pusher in the trash airlock and get the - get the trash propelled well out into the - into the waste tank. The vacuum cleaner is quite handy. I would give it a rating of very good. The improvements I would recommend is that we just have more vacuum; that's all. I realize the design of this and where our limitations are, and I think future designs - Somebody ought to dream up a new vacuum cleaner, design it from scratch, and do it so that it's got a good, high vacuum.

344 22 47 03 CDR

Ref. 3.16

The uses of the vacuum cleaner motors and the suit drying system and - in the shower, I think, are very good. Very good versatile use of the vacuum cleaner equipment. The wardroom table for non-eating uses - non-eating uses: Found it to be very useful. I would say adequate. I'd put the top on top of my tray and pu - put a spring across it. I find it to be quite happy - quite handy as a work table. The tool caddy: I think it's useless. I have not used it. Bill used it once, and he sprayed tools from one end of the workshop to the other. It just didn't work out. I think that we're better off - Instead of a tool caddy, I think we're better off with just an elastic belt. Or the pockets we have work quite adequately.

344 22 47 58 CDR

I find myself stuffing tools in my waistband as well. The portable fan: The portable fan is very useful. There's one in the experiment compartment now mounted on a universal mount. We use it to keep it cool while we're - while we're pedaling; we use it to keep us cool while we're pedaling the bicycle, and it does help quite a bit. And it - The - I think that with low and high blower speeds, it blows very good. The off-duty entertainment kit: I think the thing that we're getting the most use out of is the - are the tape recordings. I - I am reading my first book and finding that very useful. None of us has had the time to play any cards. I think one of these days we'll try, just to try it out.

A-86

344 22 49 03 CDR

But as yet we have not played any cards. The exercise equipment that's in there really hasn't been used. The exercises we're using now are more than adequate, and we just don't need what's down there. What I'm - The ones we're using are the Mark I and the treadmill, and we find them to be extremely useful. The Mark II, the springs, are also extremely useful. Garments: I would say the rating to be given on the garments is very good. For the most part, I think the garments are reasonably well designed. Lot of pockets.

Ref. 3.17

CDR

The flexibility of being able to take off the legs and have shorts and have the long legs, I think, was a very good design idea. I think the crew were the ones who were all for that and got it going. Your design deficiencies are: Number 1,

the material catches sweat and then allows the - the liquid to leave but the smell remains. And the garment - the garments appear to react with sweat, and you end up with a scent about your - your body after a while. The shirts are particularly unpleasant. The - the little pockets that were added at the end as - mainly as a result of a request by Al Bean after consultation with all the rest of us - that's great. The pockets are deep.

344 22 50 48 CDR

But the thing is, somewhere along the line somebody dropped the ball. And the pockets that are designed for the scissors are not - Well, the scissors won't stay in because the flap won't lock over the top of it. The pocket that's designed for the flashlight is too short. The flashlight comes out. It's - It's too bad because those would have been very, very handy pockets. It's just that the doggone retention straps don't hold the item in. The pockets that hold in our little trifold hooks just barely hack it. And I don't see any reason why they couldn't have added an extra half inch onto the strap or another inch of depth onto the pocket.

344 22 51 31 CDR

As it stands now, the pocket is - is not deep enough. There's about 3 inches of the hook that sticks out, and the hook is inclined to hang up on things as we sail by them. I think probably we should have made the pockets another 2 inches deeper and just had an inch of the hook sticking out. We would have been a lot better off. Light baffle in the sleep compartment is excellent. It does its job well. It allows the air to flow through it. And I'm quite pleased with mine. The privacy curtain is excellent. Works very nicely, and it's quite effective. The air diffusers in the - in the whole area are very good.

344 22 52 24 CDR

I think it was a good idea to put the adjustment features in them. I must admit, however, that I haven't used the adjustment features because they've been adjusted very nicely now, apparently by previous crews, and we're quite satisfied with what we have. The air vents in the sleep compartment: Mine is very good. The only complaint I have is that it keeps my feet cold all the time. And that's one of the things that cause me to,

Ref. 3.17

on cool days, to sleep in a half union suit in order to keep my feet warm. I don't think I want to try Al Bean's trick of getting in head - head down, turning my bed upside down. If I - if I let my head get as cold as my feet get, I would probably end up with a cold. This is the CDR with termination of M487-3 Alfa.

344 22 53 19 CDR — CDR out.

344 22 55 13 SPT — SPT at 22:55 and talking about the ATM pass which began at 21:57 for the 55 CALROC. No problem. Just carried it all out as written and also got done a little bit early; so I gave another one. I'll give you the pointing coordinates first of the first three. Building block 26 is - The first one was done UP at - UP, a plus of 2 - 128. That's a plus 1 - plus 128. A LEFT of minus 15. The next one was done DOWN to the lower LEFT of that at the UP or - DOWN of minus 55 and LEFT of minus 235. Third one was done to the RIGHT, which was, I think, UP of minus 55 and a LEFT of minus 55, also.

344 22 56 27 SPT — Coordinates on the third point was minus 55 on both. The last one which I did was an extra. I had a little time. It was done right at the center, which were the coordinates that were UP, plus 40 and a LEFT of minus 145. 56, got the exposures called for. 82A, of course, did not because of the door problem. Hope we can pick up some of those on the next orbit. And 56 also got a SINGLE FRAME; FILTER, 1; duration about 8 minutes. I spent the last 4 or 5 minutes looking for bright points and was able to just about locate one when we got into ESS. And I could not confirm that I really had one using the detectors. We had a beautiful one which I previously mentioned up there in 00:20, around 0.9, which kind of came in 1 - 1-1/2 to 2 days and disappeared.

A-87

344 22 58 46 SPT — It's not there this - was not there this morning. Was there yesterday, and early yesterday it was quite bright. I'll have to keep my eye on the XUV monitor and continually compare it with pictures which I am taking once every morning. And also I get - the same holds true for the 52, which I am taking pictures of. I have gotten another overlay

Ref. 3.18

347 15 22 14 PLT — **What sanitation problems have developed, and how have you dealt with them? Urine spills, I guess.** I have been - I've had about two urine spills, and both of them were my fault, mainly because of the peculiar way we're ... processing our urine bags. Now ... you leave them out, we get to - to evacuate them, ... chloride, and so forth. And I've saved up old clothes for that purpose; mopped up with the old clothes. Defecation for me has not been a problem. It could be. Again, you - The prob - The way you deal with them is **give us time, and that time is at a premium. I** think that anything can be cleaned up if you're given enough time. Of course, it's unpleasant and - It hasn't been that big of a problem for us. Food spill in the - in the wardroom has been a problem in that the bags have been - I've had a lot of trouble with spilling the drink bags - Or flatus bags is probably a better name for them, because that's where I think all the flatus is generated - in drinking our drink with drink bags.

347 15 23 24 PLT — I think that that's another problem, too. We generate so much flatus, we have to pass so much gas, that you're laundry marking your shorts all the time. And that, I think, probably sounds a bit flippant, but I think it's an - it is a problem. And I don't want to pass over the flatus problem lightly because I think passing gas about 500 times a day is not a good way to go.

347 15 23 48 PLT — **What is the most disconcerting personal hygiene problem you have encountered?** I think I just mentioned it - Passing gas about every 5 minutes. And I don't mean just a nice little pooh; I mean really passing a big blast of gas (laughter). It's just not a nice thing. It - it offends people around you, and the only redeeming feature is that everybody else is passing the same amount of gas. It's a good thing we got some charcoal canisters taking the stuff out.

347 15 24 16 PLT — **How effective and efficient are the cleanup procedures and hardware? The - We don't have a very good way of cleaning up. It's just swab and mop, and we use our own personal towels. The - the tissues are at a premium, and I don't want to - I find myself very reluctant to use gobs of**

345 02 05 19 PLT Get it on?

CREW Yes.

PLT All right, one of the more interesting aspects of - at least of the operation on board Skylab has been the donning of the suit, the spacesuit, or the pressure garment assembly, as it's called. We normally have the suit situated in a foot restraint, which you see attached to the floor here, and we've found that one of the more difficult things was to actually get in the upper part of the suit which - Turns out it wasn't - it wasn't too terribly difficult on the ground, but it's difficult to lean over in zero g because normally you have one g helping you on the ground when you lean over; that is, just try to bend over and touch your toes on the ground, and it makes that sort of a gesture.

Ref. 3.19

345 02 06 00 PLT Here we have Ed Gibson getting into his suit here, and Jerry is assisting him. We won't go through the full procedure for donning the suit because this is - requires very careful following of procedural cue cards. But we did - thought it may be interesting to - just think it may be interesting to look at the operation and the dexterity involved in - or lack of it, as the case may be - in - in donning the suit. You see that we do take full advantage of zero gravity in that we try to move around so that the assistant or the individual assisting has the best possible perches.

A-38

345 02 06 41 PLT Now this is, I think, the more difficult part of the operation - That's actually getting your head through the neck ring. And we find that we actually have to have another person in - in some cases, have another - another individual actually push our head down to get it down far enough to get through the neck ring. And now you see - Well, looks like - There. Jerry's helping him, and, oh, he's made it very nicely. Must be adapting to zero g. Okay, now he has his head through the neck ring, and the next operation will be to line up the material, the zipper in the suit.

CREW ...

345 02 07 33 PLT Okay. I - I'm going to cut. I'll go - I'll go kill the recorder.

CREW ...

345 02 16 50 PLT Okay, this is the PLT. We will be continuing the narration of the suit donning. We only have 3 minutes left on the video tape recorder; so we probably won't be able to get all this, other than the closing of the zippers. We had to interrupt this for the science conference.

345 02 17 12 PLT Okay. Now we have Ed partially donned in the pressure garment assembly or our space suit. And Jerry's going to attempt to close the two zippers. There's one zipper on the inside which you see him reaching for now. This is actually the zipper which closes up the inner part of the suit, which is actually a pressure bladder, a large balloon which encases the upper torso and the arms and legs - everything except the helmet, of course. And you - you'll notice he'll be very careful to hold his fingers in the right place there and to avoid any damage to the zipper.

345 02 17 56 PLT And it - it's not considered the safest thing to do for a man to don himself; so we assist each other. It is possible for a man to put it on by himself; fairly difficult. And Jerry's now fastening the - the zipper to the bladder - pressure bladder, and then he will get another zipper and close it. When - This completes this zipper operation, and you will be closing the zipper to - which actually completes the outer garment of the pressure garment assembly. And when he completes this zipping operation, you will have a lock, which will be pro - provided to lock the zippers so that they can't come unzipped.

345 02 18 48 CREW Okay, in spite of what Story said, I think we'll talk about visual observations here. We got the ATM this morning. We'll just start off here talking about handheld site 33 Alfa - -

PLT And you see that he'll be working this around, working with his fingers.

MCC ...

345 02 19 00 PLT Of course, we - we certainly don't want to damage one of these zippers, and you can see - One of the difficulties we've found in donning the suit

in zero gravity is, actually, we lose the effect of the weight of the individual and the weight of the suit, itself, in assisting us. Now in other things ..., some things are easier, and some things are harder, more difficult in zero gravity. And - -

MCC ...

PLT - - he's now completing the zipping operation of the front part of the suit.

MCC ... Just wanted to pass on ...

PLT Also attaching safety clips, which take the stress off the zipper. You will notice that this is not the easiest thing in the world to do. It requires a lot of moving around, a lot of pacing and - and stretching of the outer layers of the suit.

MCC ...

345 02 20 07 PLT And we find ourselves moving all around the spacecraft as this takes place. And the - One of the things that we miss is the weight of the upper part of the suit assisting us bringing the two edges of the zipper together. You'll see Jerry now is having quite a bit of difficulty in trying to pull the two pieces of material together. Once he gets past about the middle of the back, it'll be much easier.

MCC - - get information out of your words. I presently am writing up a new topic, 34 Alfa, which will use the fact that you can detect - -

345 02 20 45 PLT And of course, the - Notice how easy it is, of course, for Jerry to move around a 155-pound man plus 30 to 40 pounds of suit.

CC ... Over.

345 02 21 04 CDR Roger, Bill. In the area of plankton growth and plumes and all that, we've been particularly impressed by the Falkland - Falkland Current down off the eastern coast of Argentina.

MCC Yes, so have we. Judging by that, I think the South Atlantic currents are converging in there. We've certainly found your observations there

Ref. 3.19

interesting, and we're going to begin concentrating more heavily on that area.

CDR Yes, we've got an awful lot of photo coverage of that - that serpentine plume area.

MCC Good. We're hoping you'll keep an eye on it and not necessarily take more shots of it unless you begin to notice some changes in it.

PLT I concur.

MCC Okay, actually you don't see the ...

345 02 21 55 PLT Okay. What we - We got interrupted twice there with a science conference. I think we're at the end of the tape. Looks like this is sort of a bust. Oh, well, it was a good idea at the time.

345 02 22 08 MCC Okay, moving on here. This Friday, we'll be holding our first team meeting - -

PLT Droopy-drawers Gibson.

MCC - - visual observations team members will be coming in, going over the transcripts one at a time.

345 02 29 17 MCC Then we'll meet and discuss those from an assessment point of view to see how we're doing, whether we think that's the way we ought to be doing, and - -

345 02 35 52 PLT Okay, in this particular operation here, where Jerry used the donning assist - Actually, he used a strap there to pull the two pieces of the garment together so he can close the zipper. And this was discovered to be a problem peculiar to zero-gravity operations.

345 02 36 17 PLT Now he pulls the two pieces of zipper together. Actually, he pulls two zippers, they meet each other, and there's a - a lock-fastener-type device which insures, of course, that it doesn't come unzipped.

CREW There you are. Scratch my back, I'll scratch yours.

345 02 36 51 PLT

Now the zippers are fastened, and all that remains to be done is to take the zipper straps, stow them properly, remove the donning assist strap, and to Velcro down the pieces of overlapping fabric.

Ref. 3.19

345 02 37 13 PLT

So there we have the pressure garment assembly, without the helmet, donned. Subsequent to this operation, the pilot would don a secondary oxygen pack, which would be put on his right leg. That's after, of course, putting the gloves on. And he would also put on a pressure control unit, which is a special device for metering the oxygen into the suit while we are inside the closed suit. Notice the - Jerry is fitting the wrist ring of the glove onto the suit, and then he will pull the material up over the wrist ring. And he'll do the same thing for the left arm. These are called EVA gloves because they have special layers on them to protect your hands from thermal heating and also to prevent scuffing and tearing of the glove while working outside the vehicle.

345 02 38 20 PLT

A-90

Now you can look - recognize this, of course, as a helmet; actually a little bit more than that. You have a clear plastic helmet which is very strong plastic, and you just sort of pull down what's called the extravehicular visor assembly, which protects your eyes from harsh rays of the Sun, an - unfiltered by the atmosphere. There comes down the Skylab extravehicular visor assembly. And in addition to the EVA, or Skylab extravehicular visor assembly, you'll notice that they're actually, oh, garden variety wind - window-shade-like devices or Sun-shade devices, which can be pulled down to give you added sheeting and shielding from the Sun, if you're working in an area where you're facing, more or less, directly toward the Sun.

345 02 39 14 PLT

This device separates from the helmet. And the helmet will be put on first, and then the extravehicular visor assembly will be put on second.

345 02 39 40 PLT

Okay, that terminates it. I hope we've got it all in there.

TIME SKIP

347 18 47 34 SPT

Other than the EREP foot - triangular shoe platform and the one for the ATM, you've got very little to grab onto in there. Airlock: No, that's just a place to go through.

347 18 47 49 SPT

How adequate has the - the sleep restraint been for sleeping? Has it been useful for anything other than sleeping? Well, I just hang in there and read sometimes. I think it's perfectly adequate for sleeping. The one thing that I find gets in my way is that top cover which comes down, which is - Who knows what you're supposed to do with it It's always either in my face, or I tuck it in, and I can't get my arms out if I want something. The thing is just a general nuisance. I think they should have made that thing so you could zip it on or off or at least so you could have arm - armholes through it if you wanted to use them. I don't use the upper blanket, the top blanket. We don't have it on there. Just the netting, and that seems perfectly sufficient.

347 18 48 40 SPT

I think one of these nights I'm going to try sleeping without it - that is, without the outside of that, just floating free. I think that can be done, and maybe there'll be an advantage to it. So far, I've not been able to afford the - the chance of losing a good night's sleep for the experiment.

347 18 49 06 CPT

What non-eating uses have been found for the wardroom table? Would a design modification of the table and its associated restraints be desirable for any or all uses? Well, as I mentioned, I use it as a desk sometimes, with the cover on the top.

347 18 49 37 SPT

Ref. 3.20

The other day I had to take plants - elodiza pianvo - elodea plants out of the agar, and I used the table - Actually, used the food tray itself with a couple of cans in there. ... it's an inconvenient place ... table. The restraints for that table are awful - primarily the foot restraints. I think the best thing they could have done was to yank them - never put those foot restraints in there; strictly stick with the triangular grid. If - if anything, people may want to use soft shoes in there, which is a good idea. We should have had foot restraints - light - lightweight foot restraints which are portable. You can move those around and put them down there if you want them. Right now you've got ... triangular foot

347 13 27 58 SPT — SPT at 13:28 reporting on the photos taken of triangle shoes. They were taken on mag CL110, f/8, 1/60 with a flash attachment; frame number 51 - No, make that frame numbers 52, 53, and 54. Correction, that was frames number 51, 52, 53, and 54. The first three were taken of all three triangle shoes - all three sets - on the grid, all from the same angle, all - each one with three different angles: left-side front, right-side front, and back. And the last one was taken of the SPT's left heel, which has become fairly unglued. Let me describe the conditions of the shoes in general, that is, what seems to be characteristic of all the shoes and of the SPT's heel.

347 13 29 34 SPT — Okay, the toe guards which were set up have done a good job. I wore - did not have the toe guards on for about the first 3 weeks, and I could certainly see the wear of the toes. Wherever there's a hard surface underneath, it tends to help wear through quickest at that location. With the toe guards on, however, it seems that they can be quite adequate. As you'll see, there's a lot of scuffing and discoloration of the toe guards but they're holding up real well. We don't expect to have any problem with them. The only problem encountered in the toe guards is that they're very hard to install. And in my set in particular, there was one screw, the one at the very tip on the left shoe, which I could not get in. And I have worked with the - for the past several weeks without that screw in there, and it seems to be in no way a detriment to the shoe or to myself.

347 13 30 37 SPT — There is not much wear on the side of the shoes - just an occasional amount of abrasion. I think you can see that's very minimal at the largest width of your foot, say right below the small toe, if you will, on the outside. But that's minimal and is more of a discoloration or dirtying of the canvas from wearing. The other real wear points come in the back and - that is, with everybody's shoes, there is a ridge which runs vertically down the back on the inside, a stiff - very stiff one, maybe 2 inches across at 1-1/2 inches across. At the border to these ridges, the canvas is stretched and encounters a fair amount of wear and stress where they have started to come through on almost everybody's shoes.

347 13 31 49 SPT — The CDR and SPT have - the CDR and PLT have put tape over those locations and I'm about to do the same. Now one part of the SPT's shoes, on the back on the left, have undergone a pretty healthy tear. And that is the - right along the bottom edge of the very back, parallel to the ground. The bottom has been ripped straight across.

Ref. 3.21

347 13 32 40 SPT — And that occurred one day on the bicycle ergometer, which if you put your heel back down at the bottom stroke, rubbing your toe down - if you put your heel down, which I just happened to be doing because of the way I was pedaling one day, you can catch it on the triangular grid. And with the force of your other leg coming down and the inertia of the system, you just flat rip the - the back. It has not slowed me up at all and has not gotten appreciably larger, and I expect that if this'll hold up at least until halfway through the mission, we should have no problem. In general, the shoes are wearing, but the thing is, we've got another set of canvas on board that we'll put in about halfway through. Seeing as we're about a third of the way through now, it looks as though we're pretty much -got it made. We - we expect no problem with them.

347 13 33 33 SPT — SPT out.

TIME SKIP

347 14 51 26 CDR — This is the CDR at 14:52 [sic] and 30 seconds. We're beginning the S019 operation. The SAL DOOR is OPEN. The mirror is EXTENDED and set at a ROTATION of 31.0 and a TILT of 6.2. The first field is number 213, and exposure will start at 14:54.

PLT — ...

CDR — Okay.

347 14 53 10 CDR — The nu_z correction is zero. The nu_z in the ATMDC is minus 2.4, and on the pad, it's minus 2.5.

347 15 27 13 PLT

How comfortable are your garments in terms of fit, warmth, and don/doff ease? Fit: I lost a lot of weight. I can't complain about the fit because they fit me when I was about 15 pounds heavier. Warmth: No problem. Don and doffing: Well, that's a good question. The jacket has the sweatshirt-type insert at the sleeve. I find it difficult to get the jacket on and off with a wristwatch on, particularly if you have to use the - the passive radiation dosimeter on your watchband. I finally took the PRD and - the passive radiation dosimeter off the watchband because it - it was so cumbersome. So one of the things I think we need is the ability to put trousers on and off without taking your shoes off, because that causes a lot of trouble. And also, the sleeve opening needs to be just a little bit more flexible. I - I like the idea of this sweatshirt-type sleeve, but - Also, the sleeves are too long. Now all of my sleeves are about an inch and a half too long; I've rolled the cuffs up to a sort of jacket. And I think that's a fit problem. It was just not quite tailored properly. The - They just hang down too long on the arms.

A-92

347 15 28 31 PLT

What recommendations do you have for improving IVA garments? Do they tend - Well, that's first. Do they tend to snag as you move about in the OA? Yes, they do. The pocket that holds the little Flight Plan book and also the scissors pocket tends to snag, but you could - I finally took the cord off my scissors because I figure it was a safety hazard. The pockets are also inadequate. We've already commented on those before, but they just almost made them good enough. You know, it was just like if they'd have just used 5 more minutes of time and thought, they could have made them real nice, because the way they are now is just sort of marginal, useless, although we - Of course, we do use the Flight Plan pocket ... the little straps aren't long enough. I - The little pocket in front, I think, was supposed to be used for pencils; however, it just - just accommodates a flashlight. But this - this flap isn't long enough to really hold it in. I keep losing it. So I finally stopped using it and went back to using it for pencils. The scissors pocket: Again - again, the flap is not quite long enough to really give you good positive retention of the scissors

and you can knock the scissors out of your - flip them out real easy if you hit something.

Ref. 3.22

347 15 29 41 PLT

What recommendations do you have for improving IVA garments? Well, any place there's a zipper, there ought to be a zipper-pull tab on the zipper, if it's nothing more than a little inch and a half lace or cord or - with a knot on it or something like that. But I find myself irritated by having to dig and hunt and probe for the little zipper-pull and - in order to get at a flashlight in a hurry. Also, any place there's a zipper, there ought to be an opposition pull-tab. In all, I don't think that's so critical on the clothing here. But they - they just left these off every place. And I don't think the people really knew what they were doing. I mean I - I've seen an awful lot of things designed with zippers that have pull-tabs on the zippers and opposition pull - -

CREW ...

347 15 30 37 PLT

Anyway, that's my comment on zipper pull-tabs. And what have you detected in environmental elements discussed as the last question in the first debriefing? Have you used any of the M487 to document these changes?

347 15 30 47 PLT

I'll have to answer that later. I have an AIM pass now.

TIME SKIP

347 15 55 23 SPT

SPT at 13:55 [sic] for M151. Just starting the M092 run now. SPT, observer; CDR, subject.

347 15 55 35 SPT

SPT out.

347 15 59 33 PLT

PLT, debriefing the ATM pass started at 15:14 - actually 15:32. JOP 9, step 1, building block 2, performed per pad. I left DETECTORS 6 and 7 on there when I first started the set at 2500 - and first started the MIRROR, AUTO RASTER. Ground call, I got that off. Other than that - that was performed nominally - truncated at 6; got the nuz update.

hour. The net result is, you end up being uncomfortable for a good part of the day. I think a lot of this is a requirement put out by the experiment itself. And the time can certainly be cut down to far less than that if the experiment did not exist. But the way things are right now, the process just takes too long.

347 19 05 53 SPT

How effective and efficient are the cleanup procedures and hardware? How much of a timing imposition are the cleanup chores? I don't find that to be a problem at all. Pretty much stay on top of it as they said it would happen. So it's no real problem. How adequate is the ATM chair? Haven't used it yet. It is readjusted for each crewman? No, we don't use it. Do you use the shoes or grid with it? No. The toe bar useful? No. Do you use the chair anywhere other than the ATM? We've got it stashed up there in the top of the OWS. What design improvements do you recommend? Eliminate it. The reason I gave all these negative comments on it is that when you're operating in the ATM, I personally have to reach all around from one side to another. One, I use the timer over on the STS for some function. I use the - as I look at the time, I have to turn the VTS ON or OFF - the VTR ON and OFF. Information - Experiment information is stowed off on a panel right behind me, which I use to get over to - to open the container for the book. I use that quite often.

A-93

347 19 07 10 SPT

I generally just have to reach all around, and also, I don't like to be confined. Many times, when I don't have my hands on a switch on the panel, I lean back and move all around. I find it much more enjoyable to work when I'm not confined. We will be giving that thing a try, though, in the future, just to fill the square.

347 19 07 29 SPT

How comfortable are your garments in terms of fit and warmth and don/doff ease? All of those are not too bad. Were they sufficiently resistant to tearing and abrasion? Yes, they're sufficiently, although I have imagined the value of the next question. I went into the airlock one day, and I had the bottom of my pocket - the zipper in my pocket on the bottom left leg open. And it caught on something and just ripped the pocket halfway

Ref. 3.23

down. I was really whistling along, though. What recommendations do you have for improving IVA garments? Well, one is, even though I like these pockets, I'd like to have a couple garments around here which don't have these blooming pockets, that I could use just for comfortable, casual wear. I'd also like to get some different colors. I feel like I've been drafted in the Army with this darn brown; it gets pretty obnoxious after a little while.

347 19 08 30 SPT

I'd like to get some different colored T-shirts. Sweat shirts might not be a bad idea, but probably T-shirts are better to go with for right now - either that or just pullover cardigan type. I think they're plenty warm. Might think a little too warm. The pockets on the gear, though, is not - for the flashlight, is not too sterling. The pocket is either too small or too big for whatever you want to use it for. This pocket, I just don't use. I put the pencil over on the inside pocket on the top left thigh. I use the one pocket in the back to hold the - my schedule book, although I think that the flap on that is too weak - the Velcro is too weak. The po - or the flap itself is too short; just barely makes it.

347 19 09 30 SPT

The pockets on the back right-hand side, which I guess one is a pencil pocket and one's a flashlight, are next to useless because they're too small for a flashlight or too big for a flashlight. The flashlight gets lost in the center pocket and comes out of the other one. I have not found them very useful at all. One thing I would like is to have a couple of plain old handkerchiefs around here. Not quite too sure why we have to go around plucking tissues out of every ... all the time. I would much rather have the two handkerchiefs, and we are running short on tissues and wipes.

347 19 10 16 SPT

What changes have you detected in the environmental elements discussed in the last question in the first debriefing? Have you used any of the M487 instruments to document these changes? Environmental elements: Can't say - environmental element. Okay.

347 19 10 47 SPT

No, I have not done light surveys. Spot meters, I've only used for photography. No, I have flat

for cleaning, because there's too many nooks and crannies around the cover. I think next time we design something like that we ought to design the tops so that they're nice and flat and easy to clean and there aren't too many hooks and nooks and things like that to - to tear up your wipes and everything and make it difficult for you to clean.

347 22 35 31 CDR Let's go on now to question number 7. How adequate is the ATM chair? We have not used the ATM chair, and none of us is of a mind to try to use it. I think, just in deference to - to you folks, we probably ought to get up there and stick it in and - and run one ATM pass with it, but quite frankly, I like the freedom that you get by standing up. I like the - the more reach that you get, and I don't think I'm going to like the chair. I'm sorry that I'm prejudiced already, but we'll - we'll give it a try one of these days.

CDR Do you use the chair anywhere other than at the ATM? No, we haven't used it for anything. And what design improvements do you recommend? I guess I recommend that we don't have a chair next time. It's really - I don't think it's needed. How comfortable are your garments in terms of fit, warmth, don/doff ease? Were they sufficiently resistant to tearing and abrasion, et cetera, et cetera?

A-94

347 22 36 36 CDR Okay, I found that in terms of fit and warmth that my garments are quite comfortable. I quite frankly, as I mentioned earlier in an earlier debriefing, do not wear the brown shirt because they get to smelling so bad after you've got them damp. So quite - quite frankly, I pretty much stick with the short trousers and a T-shirt, and I'm quite comfortable that way. And in the event that I have a - a tour of duty at the ATM or in the command module and I'm going to be there for a while, I zip the legs in, and I even bring a coat if I feel it's necessary. But I find the ad - the garments are adequate in terms of fit and warmth and don and doff ease, and that they are flexible enough so that they can be adapted to the environment that they're going to be in. They are sufficiently resistant to tearing and abrasion. I have not yet torn or snagged one at all. Do they tend to snag as you moved about the orbital assembly?

Ref. 3.24

347 22 37 39 CDR One thing I mentioned last time a - about them snagging, and that is the - the book pocket. There's one on my left hip. The book - The pocket's not long enough for the book, and the book's inclined to snag on things. Other than that, it's okay. I've already discussed my dislike for the other small pockets that are on here - because the - the ones that are designed for scissors don't have a flap long enough to cover the scissors; the one designed for the flashlight, the same. And so you end up having - you put things in those pockets, and you put the scissors and the flashlight in other pockets.

347 22 38 16 CDR The fact is, I think the way it stands now, I have my flashlight in my scissors pocket; I have pencils in my flashlight pocket, and I have my scissors in the upper right leg pocket. And every time I raise my right foot to tie my shoelace, I jab myself in the groin with the scissors. The - the most important recommendation I would have for the IVA garments is, for crying out loud, let's be more careful about how we design all these little special-purpose pockets and make sure they fit, with a little bit of leeway, the things that you intend to put in them. And I don't know what to tell you about the shirts. They catch the - the sweat, and they allow the water to - to evaporate; and the rest stays, and they smell. They react with the sweat and pick up a real smell. Okay, so much for that one.

347 22 39 17 CDR Question number 9. What changes have you detected in the environmental elements discussed as the last question in the first debriefing? All right. The last question is lighting, noise, temperature, humidity, airflow, and all that sort of thing.

CDR What changes have I detected? Well, temperature, of course, I've noticed was hot when we got here. It cooled off and was quite comfortable, and now we're back up into a hot cycle again. It's starting to get warm; OWS temperature is about 75 to 77 degrees now.

CDR And the system can't keep up with it and it's just getting warmer and warmer, but, thanks heavens, we can doff clothing and stay reasonably comfortable. The humidity in this - As the temperature goes up,

hot right now? 25 at 0.4 may be the one; so make it 01 is the one. I took another look at it after the JOP and after the observing time, and did not appear to - to be particularly active even in the XUV MON. I did not look at the corona.

354 16 03 29 PLT — PLT out.

354 16 12 14 SPT — SPT at 16:12. M151. Conclusion of M092. Start of 171.

354 16 12 19 SPT — Out.

TIME SKIP

354 16 34 37 SPT — SPT at a 20[sic]:34, with a message for FAOs and anyone else who gets involved in flight planning. Okay, this morning on paper our schedule looked fairly straightforward and relatively easy. Met all the guidelines and just looked as though you could zing right through it. Let me tell you, blow by blow, where thing go awry. Number one: After my first ATM pass for the day, S019 was going. Could not use the tape recorder for the debriefing; so I recorded what I could on paper so I would not forget the details to be recorded later by voice.

A-95

354 16 35 27 SPT — After the ATM debrief, I had 13 minutes before the - After writing it down, I had 13 minutes before the ATM conference. I came whistline down the OWS; pulled Jerry away from hes work. We had 10 minutes at that point and concluded we had insufficient time to do the limb-volume measurements - about enough time for me to get my drawers off and pull out the tape measure - so that was not accomplished.

Ref. 3.27

354 16 36 05 SPT — At that point, the ATM conference was coming up. Then we had our S233 going on - all coming up in the MDA at the same time as the conference - just when all the lights had to be out. So at that point, I had to go up to the ATM, get any paper work I needed for the conference - which included a couple of photos, a couple of notes I had made, the ATM schedule - bring all that down to the wardroom. Okay, at that point, I still had a urine drawer which was not empty - not changed out.

probably allow more on the order of 30 minutes. If you're going to do just one man, allow 15 minutes; if you're going to do two men, you should probably allow 20 minutes; and for three men, 30 minutes.

357 04 57 35 CDR — Okay. The next down the line is M509-1, 2, and 4. Bill and I both have felt crowded the last two times. We think maybe you ought to allow 3 hours and 30 minutes. Give us an extra 15 minutes, and if we start getting ahead, we'll give it back to you. S019 Papa Romeo 2, we think we can do that in 35 rather than 45 minutes. S019 Sierra Tango-1, we think we can cut back from 40 to 30 minutes on that. We can do that in 30.

357 04 58 06 CDR — Going down to S063 Hotel Papa Romeo. We've never done it before. Looking at the procedures, we estimate it'll take 30 minutes to do it the first time. And if we get better, we'll cut the time. S063 Hotel Oscar Papa - In fact, all of these 04 plus data take plus 02 entries, we don't think we can get ready to do anything in 4 minutes. I can't even get ready to do an S232 in 4 minutes.

357 04 58 38 CDR — So I would like - S063 Hotel Oscar Papa to be a 10 data - 10 plus data take plus 2 is okay. S063 Kilo Hotel Papa Romeo, both to 30 minutes. Kilo Hotel Oscar Papa, 10 minutes plus data take plus 2. The stow is okay. S073, S183, we don't have anything to argue with there. S233, the data take should - It should be a 10-minute plus data take plus 2 because you've got to go in, you've got to close the hatch, you've got to turn off all the lights, you've got to make sure your watch is running prop - properly, set up properly, you've got to open the window, set up - make sure the camera is pointed in the right direction. And you just don't do all that in 4 minutes. You really need 10 to do that.

357 04 59 40 CDR — Stereo photos for all three guys, we think that ought to be 45 minutes. It takes quite a while to set up all three cameras, get the string, get all that junk put up, get three guys undressed, get two guys positioned, talk over what you're going to do, and get your signals all down square and everything, and we don't do that often enough

Ref. 3.28

triangles in there; we need flow throughout the whole room. That exhaust fan does a good job, but I'm not sure where it's coming from. Must be coming through the door. What we really ought to have is some way of sucking the air right up from below, same as we do in the - in the other r oms. Thermal comfort's adequate. Noise level's great. Illumination's fine.

361 04 23 25 SPT

Okay, in the sleep compartments; general arrangement and orientation of compartments. General arrangement: I would like to have it so that the SPT doesn't have to go trudging by two other guys on the way out in the middle of the night and wake them up. I think the arrangement ought to be such that three guys could have access to the sleep compartments without having to go through or immediately adjacent to the other two. The compartment, itself, is too small. I think what we need in there are some locations where a person could sit down or at least, if you will, sit as best he can in zero g and work. You need a small - small desk in there. You need better, more provisions for your personal equipment. I've had to take and restow lots of things - take the trash-bags out of there, which have no place in the sleep compartment, a whole host of other things, and try to make a little more provision for some of the things I'd like to have immediately accessible to me.

A-96

361 04 24 35 SPT

Ceiling/floor proximity is fine. Ingress/egress provisions, I just discussed. Trash collection is fine. Stowage volume and access, I've just discussed. Again, that is poor in that stowage volume for personal items is negliaible. Access to them: I would just as soon use a few more walls for that. Temporary equipment restraints: There are none. Personnel mobility aids: None. Personnel restraint devices, other than the sack which we've already discussed, none.

361 04 25 13 SPT

Thermal comfort: The SPT is into - two things. It's either too hot or too cold in some instances. If it's too cold, I put my feet right down there by the blower or the vent coming through the floor. I usually wear one or maybe two pair of socks at night just so my feet don't freeze. And

Ref. 3.29

I don't know. It's no - no design feature, but on the - when we get to high beta angles, the SPT's sleep compartment gets rather warm on the wall there because there's one part of the wall there which is not shaded by the thermal shield outside. Noise level: Fine. Illumination: Great.

361 04 26 03 SPT

Experiment compartment, general arrangement and orientation of compartment: Okay, here I would like to see us start using walls a little bit more. We've just got bare open spaces on walls. I don't know why we can't use equipment. It's really a one-g device. OWS is one g. That's one feature I do like about the MDA, is that at least we've managed to make use of all the walls. The walls are the working area.

361 04 26 35 SPT

I said this whole OWS is essentially made for - made for working, for training in one g.

361 04 36 32 SPT

*** photography or for better vision, for one reason or another. They could do it in the airlock. Well, what can you say about it? And airlock is an airlock. The tube - the tube is a tube. There's not much else you can do with it. General arrangement and orientation of the compartment for EVA is adequate. Volume: Well, I think it could be a bit larger. Run into a few instances where we had tough times planning for an EVA and - and stowing of gear just because we don't have enough room in there. I'm afraid one of these days we're going to kick one of those delicate pieces of gear while we're in there and really mess it up. I think the volume could at least be 50 per - should be at least 50 percent larger for that kind of operation. Getting yourself in there with all that umbilical and - and in a situation which may require that you have a volume available to you for crew safety, I don't think it's good - a good design in terms of volume. You just flat need more.

361 04 37 43 SPT

Ceiling/floor proximity: Yes. That's not applicable. Ingress/egress provisions: They're great, one after the other. Trash collection provisions: There are none, but you don't need it in there. You're always passing through whenever you'd be in the mode of making or generating trash. Stowage

more than adequate. I've learned to use them, and I think they're super. But there's no handhold in there; just flat nothing. There's this gear which I have to grab onto. I think in the [illegible] the one-g layout that you have down here in the experiment compartment, you don't need handholds out in the center of the floor. Up there in the MDA, I think you at least need some handholds or something to grab onto to move from one place to the other - sticking out a little above some of the equipment because that equipment - some of it's fragile; some of it's just flat bareside. One thing I have a deathly fear of is grabbing those rate gyro and sending us off on a - rate gyros off on a wild goose chase. Granted they were not supposed to be in there to begin with, but now we shouldn't have that worry about delicate equipment.

361 04 47 51 SPT

Ref. 3.30

Thermal comfort: It gets a little cold [illegible] I had to take a jacket up there to work [illegible] ATM or anything else. I come down to the LWS, and I find myself taking the jacket off, sometimes the T-shirt. I know we got an instr[illegible] temp there. Noise level: Way too high. Aside from [illegible] which I mentioned, we've got rate gyros in there. And they're both making so much racket. I don't [illegible] what noise level exists underneath [illegible] those. Granted the rate gyros were [illegible] feature. But the fact is, they're in there and they do make a whale of a lot of noise. Gradually, you tune it out after a little while, but - For example, when you're recording, it obscures the recording. I don't think you can think as clearly in there, as you - as you might be able to without all that racket right behind you. I think anything like that ought to be greatly reduced. Interms of energy, a factor of 10 to 100 or so less than what it is right now - that's noise energy.

361 04 49 02 SPT

Illumination: Again, it get - it's a little dark in there. I think we got enough light scattered around to really get good photography. You have to take and bring in some high-intensity lights. For some reason, the lights we have in there - matter of fact, all throughout the whole spacecraft - are just low illumination. I don't know

A-97

S183. Usually took about two men to get that thing eased into place in the OA. In the trainer, and here one guy can handle it very easily with one hand with no problem whatsoever. It's just a matter of taking your time and letting the inertia work for you rather than against you.

365 18 18 03 CDR

Part C, work activities requiring assistance from other crewmen: I don't see any either detriment or beneficial thing there. Personal maintenance activities - personal hygiene, donning and doffing garments, and all that: Personal hygiene, the act of defecation is made more difficult because the - the waste products don't move away from you and you have to pull them away from you. That is definitely a disadvantage.

CC

... and we'd like to point out to you that the item at 19:13 is non-time-critical and that we certainly don't want to cut - cut into your JOP 18 maneuver. You can put that off until 19:17, 19:18, something like that.

CDR

Was that for me?

PLT

[illegible].

CDR

Okay.

CC

Whatever you need.

CDR

Donning and doffing of garments is really easier in zero g than it is in one g, with the exception of your shoes and socks, things that require you bending. We were quite surprised to find out how much we use gravity when we bend over to tie our shoes or untie our shoes or put on a pair of socks or something like that. Up here, you've got to use those stomach muscles to pull your foot up close to you to tie your shoe or work a sock or something like that, and it really works the old stomach muscles for you.

Ref. 3.31

365 18 19 22 CDR

Waste management cleanup chores: Okay, I guess I - I called that personal hygiene, and that's already covered. Locomotion in and through various OA compartments: Zero g almost invariably works for you. The forward compartment of the workshop

can become a problem in locomotion and moving; and that is, if you allow yourself to drift away from a handhold and it's 20 feet to the next handhold, you got nothing - you got no choice but to be patient and wait until you get there. So you have to be careful in the large dome area, forward compartment. And if you want to go somewhere, point yourself and go; and it's no problem. But if you want to stay where you are, you better anchor yourself; because if you start drifting off and get without reach - outside the reach of a restraint, then you're - you've just lost time. And you can flail and thrash all you want, and it won't do you a bit of good.

365 18 20 23 CDR

Ref. 3.32

How satisfactory is the frequency of change of bedding, clothing, towels, and washcloths? I don't think the bedding has to be changed quite as much as - quite as frequently as it does. I think the clothing frequency is fine. I would prefer to have a clean pair of underwear every day and a clean pair of socks every day, rather than every 2 days. But I think we came across a stowage problem there on that, and I understand the problem and we can live very nicely with what we have. Okay, this is the CDR. I'm going to terminate this because other people need the recorder. And I'll try to get back and talk a little bit more about question number 5 later.

365 18 20 56 CDR

CDR out.

365 18 21 26 PLT

This is PLT. The time is 18:21. And the exposure terminated prior to 18:21. And that was for field 043. TILT was 0 - 10.3; ROTATION, 166.3; for PLATE number 20; 000/000/0620. So we got by in fine order on those two exposures. I'm starting to now - to do the stow on 183.

365 18 21 58 PLT

PLT out.

365 18 25 15 SPT

SPT at 17 - Make that 18:25. And this is some of the TV which can be fitted into TV-77. If you will, shift this portion into the part that I'm about to record later on, which - This will show the pointing of the comet. We're now looking at the display for the white light coronagraph. And down in the lower left is a very faint object which turns out

various sized equipment items - small, medium, and large: Apparently, the - the big help is that you don't have to worry about lifting against the one-g force field. And the big problem, of course, is - is moving from one place to another and not binging something in the process. Other than that, I don't think there's a big problem, and I think it's quite easy to move things around in zero g. You just have to look where you're going.

365 22 00 41 PLT

Work activities requiring assistance from another crewman: Not too - That hasn't been too much of a problem. We usually can pass things to each other in zero g quite handily. As far as working together in zero g at a specific location, I don't know. Personal maintenance activities - personal hygiene, donning/doffing garments: Well, bending over to tie your shoes is a big task.

Ref. 3.33

365 22 01 10 PLT

Putting the suit on for EVA is a big task because anything that requires you to bend over like that turns out to be a - about three or four times, maybe 10 times as hard here in zero g as it is in one g because, strange as it may seem, that one-g force field pulling your head and shoulders and torso down really is a big help. And donning the suit, we've found is extremely difficult just from the standpoint of the - the difficulty of bending over at the waist.

PLT

Waste management and clean up chores: Again, water spatter is a big problem there. I've already mentioned having lots of tissue and certain types of blotting devices for handling the problems that occur - peculiar problems that occur in the waste management area. But I think in the future, in spacecrafts you ought to be able to have one place for washing your hands and shaving and that sort of thing, and another place for going to the bathroom and taking care of the bodily functions. It's - I think it's preferable from a hygiene standpoint, and I think it's also preferable from a traffic flow standpoint.

365 22 02 12 PLT

I think that the - you ought to have a place to wash your hands and a place where you defecate and urinate, but you also ought to have a separate place for shaving and taking care of routine primping and - and - and cleaning up - combing hair and

washing, brushing your teeth. And - I - I personally don't like these little Bopp kits too well. Now Jerry likes them and thinks they're great. I just think there's a better way of managing them - managing that - all those items.

PLT — Locomotion in and through the various OA compartments: That's no big problem. I just - We just have not had any problem there at all. And the only thing that we have to worry about is, in the MDA, we have the rate gyros in there. Again, this is not - not another kick against the MDA, but if the - if the rate gyros are located in there, we have to be very, very, very careful.

365 22 03 00 PLT — Windows are another thing that you have to be careful for because you just get carried away with the ability to move rapidly in zero g.

Ref. 3.35

PLT — How satisfactory is the frequency of change of bedding, clothing, and towel/washcloths? Okay, frequency of change of bedding: I just think that we don't need to change it as often as is specified. Clothing: Well, I would like to change underwear every day. We don't have enough. This is why I think maybe the washing machine might help. Towel/washcloths: We should have - I think we ought to have two towels - or, excuse me - yes, well at least one towel a day, preferably two, and two to three washcloths a day or a way to clean them, wash them. So that's what I think about that.

A-99

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365 22 03 40 PLT — PLT out.

365 22 17 23 SPT — SPT at 22:17. HHlll, Agua, Blance Fault. Just a quick observation out the window as we came across it around 2 or 3 minutes ago. The first thing that I saw was the Gulf of California. I can see it very plainly as it's drawn in the figure. Well, let me refer you to it. Hold on.

365 22 18 01 SPT — The figure is example 10-6 in our book. And I can see it just about as far across as you have it drawn there; that is, maybe 3/4 of the way to the coastline. But then you lose it for a bit, but then it seems to pick up again. But rather than being a - a fault that looks like a river

getting the camera out. Let the fil - let the camera stay right where it is, float, get the new filter out and put it on; put the window on it - or put the window on the - the CAL, then put the whole thing on. And you can do that real quick.

SPT — It's amazing. You would think the things up here which you know on the ground weigh an awful lot would feel more massive, but they don't. Even like, you know, another - another body, if you push him around, 180 pounds, or I guess both ... Jerry and Bill, 150 pounds - very light, very easy to move.

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003 03 01 18 SPT — Personal maintenance activities: personal hygiene, donning/doffing, so forth. Well, certainly the personal hygiene has been complicated by zero g; there's no doubt about that. It's just that one g is - I think that's plainly obvious there.

Ref. 3.36

Donning/doffing garments: No problem. I find it just as easy in one g as zero g. Probably you do need a room that's something kind of like my sleeping compartment, a little larger. But you don't need it much larger. I find when I'm putting on things, for example, I'm usually bounding around inside there like a ping-pong ball. But the room is small enough, and you're - you're bouncing alow enough that it doesn't seem to be a problem.

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003 03 02 37 SPT — Waste management and cleanup chores. Waste management and cleanup chores: No problem. In terms of cleanup, I think the waste management itself is big - the big thing, urine. Although I think the urine - the urine system is okay. It's very quick. I think it's just about easy as zero g. Taking care of the bags and cleaning up the - the urine drawer and doing all of the associated things with the experiment first thing in the morning - the measuring, taking samples, dumping, that's just - and putting the new bag in - that - that just takes an awful lot of time. Just a lot of small - small items, packed, one stacked up after the other, just all take time. And I think if you got rid of the experiment and you were able to just flush the stuff right overboard, there'd be no problem.

you got to go back and very carefully get them all off, make sure they're all off before you can open what it is you want to get to. And that's a time consumer, that's a real waste.

022 18 24 16 CDR *** I think I mentioned that to you in an earlier briefing when I was howling about the film vault, and I still feel just as emotional about that dang thing. We really let a bad one get by when we didn't force the issue and require that retention in the drawers be taken care of and a decent latching system be used on the doors.

022 18 24 36 CDR CDR out.

TIME SKIP

022 18 50 35 SPT SPT at 18:50, M487-2 Delta. How effective are the various tools used thus far, particular, which are poorly suited for use in zero g? Do you find that you needed any tools other than those provided in the kit? Okay, I'd say the most of the ones that I used so far are very effective. There's not much about using a tool in one g that's different in zero g, in terms of the - the tool and the structure that you're working on. Retention of the tools is somewhat of a problem, however. You do have quite a few tools that you're working with.

CC Skylab, this is Houston through Guam for 10-1/2 minutes with a data/voice tape recorder dump.

SPT Ah, they're dumping the data/voice recorder. Well, that blows this. So I'll have to pick this thing up later. Well, hold on. Houston, I was in the debriefing at this point, can you hold off for that tape dump?

CC Will do.

002 18 51 56 SPT Thank you. Okay, the problems that I have encountered with the tools is first of all, the - to go get that tool carrying kit, that is always a

problem. I found that it's a heck of a lot easier just to put the tools in your pocket than to go round up that other thing which looks real official, but really is just a big time consumer. Once you're working on a surface, however, you'd like some way to hold it down and if there's no Velcro handy, then you're a little bit stuck and we always end up using a little gray tape. Take a piece of gray tape maybe a foot long or so and attach it to something and then hook the tools on the loop. Anywhere along a couple of inches here or there. You - you use that gray tape pretty much in that same manner for a whole list of things.

022 18 52 53 SPT If there was some other way of holding tools, I'd most welcome it. Individual tether -

SPT ***tools are provided? Yes, I think I could use a different type screwdriver. I think I was trying to put the - put my shoes back together again. Put the toe on and I had to put a - a new covering on over one - the right - my right shoe. And those screws on the bottom are a little bit too large for one size screwdriver and too small for the other. And you got to put a lot of force on those screws and a lot of pressure. And I find it would have been useful to have a screwdriver which would fit, and we didn't have it.

022 18 53 49 SPT Two of them that - that are in there - No, I can't. I've usually been able to make almost anything - I can get almost anything I needed to get done in one way or another. I find the Swiss army knife is an exceptionally useful tool itself. The postural adjustment is question number 2. What postural adjustment have you had to make in order to accommodate task performance in zero g? First one is at the ATM panel; I wish that the flooring was a little bit lower there. I find myself having to continually bend over; was much worse at the beginning of the mission when I was used to the simulator. Now, I'm used to working a little higher eye level on the ATM panel, but I still find myself bending over and that is somewhat of a problem.

003 03 03 45 SPT — Cleanup chores. I don't find those to be any worse in zero g. Well, I guess I do in a way. I think when you're working with a - with a washcloth and it's wet, filthy -

CDR — JoAnn said she was really scared for him; that's why - -

SPT — And you splash it around -

CDR — - - to be - be sure and not let anybody pick him up again ... mistake.

PLT — I'll speak to Sue ...

SPT — Then it tends to splash all over, and goes in one direction. On the ground, of course, it all ends up straight down and you can get - a little easier cleaned up.

003 03 04 29 SPT — Locomotion in and through the various SA compartments: No problems. I find I can push my way around this place pretty quick now. And, relative to zero g or one g, I find it'd be a heck of a lot harder to walk around. Certainly in the one-g trainer it was always hard going up and down stairs. Around here I could go whistling from the command module down to here and make the trip in 10 seconds.

A-101

Ref. 3.38

SPT — How satisfactory is the frequency of change of bedding? No problem there. We have more than we need, way more. Clothing: Well, I think I'd like to change my shorts and shirt once a day. Towel/washcloth: Okay, we got more than enough of those. I guess socks - socks, shorts, and shirts I'd like to change more, at least once a day.

003 03 05 19 SPT — SPT out.

003 03 11 22 PLT — Okay, PLT. Subject is M487-1 Alfa, Charlie, and - -

CDR — Bravo.

PLT — Bravo. I'm going to read off the levels of the sound meter first. And this - these were taken over a period of time. Okay, wardroom, over the table. Temperature was 72.3 degrees. Ambient

[illegible]

Ref. 3.40

[illegible]

016 00 28 27 CC — Roger.

[illegible]

CC — Roger, Jerry. We see it.

CDR — Heck, I'll bet it's more like [illegible] miles.

CC — Roger.

016 00 29 28 CDR — With the PLT's shoe problem, we told him if he pulls up lame, we're going to have to shoot him.

CC — (Laughter) Roger. And, PLT, Houston. If - if that window will let you, we'd like you to look as - as close to nadir - nadir as you can.

CDR — That's almost impossible. We'll give you the best we can.

CC — Okay.

016 00 30 05 CDR — You can almost not see the ground at all, there's so much haze now.

	PLT	Press on, Dick.
	CC	Okay, here's one on T002, Bill. We noted in - in - noticed in the data some large biases in the sightings including the zero reading. And it's - the data's sort of similar to a couple of sessions in Bean's mission, and - when the transparent wardroom window protective shield was left on. And we were - just wanted to confirm that the sheet - the shield either was or was not removed for this particular sighting.
	PLT	That might have been it. I - I'm not sure.
017 00 10 44	CC	Okay, one other quick one, Bill. Before I do, we're about a minute from LOS; Tananarive at 00:29. Another one is you reported a triangle snow failure. We wanted to know a little bit more about that. What were you doing when the right shoe failed, and do you have any comments about the design as to whether or not you think that contributed to this particular failure? And - and also what kind of loads did you have on the shoe at the time it gave way?
Ref. 3.41		
A-102	PLT	I had my foot in a triangle in front of the film vault. And, Ed, to move the door, it hit the side of my foot. (Laughter) And I think, however, in all due respect to Ed, that - that the metal had already been fatigued.
017 00 11 32	CC	Okay, we're going over the hill here. If - if you did want to add any more about that, why don't you just put it on the voice recorder, and we'll pick it up. Thank you much, Bill.
017 00 29 19	CC	Skylab, Houston. Hello, at Tananarive for 5 minutes.
	CDR	Roger, Dick. On those two SOPs, number 006 has got 6000 and 013 is 5800.
	CC	Okay, Jerry. Sure appreciate you taking the time to read them down to us. We appreciate that. And I've got a change to the ATM schedule or an addit - slight addition to the ATM schedule pad for someone for this daylight cycle that begins - upcoming here at 00:35.

		about right - Negative, no, it was later than that because we had the limb blood flow. I don't really know; you'll have to check on that from when the data came down on M093. It usually takes us about an hour and 10 minutes to do this whole thing. Okay, the data is as follows: The PLT's left calf measured 13-1/4; his right calf measured 13-1/8. The legbands that were used were Charlie Juliett, with a cal adjustment of 2.5. And Alfa Quebec was used on the right side. And that's all the data you need.
022 02 35 14	CDR	CDR out.
		TIME SKIP
022 12 09 59	PLT	Okay, this is PLT giving M487-2 Delta crew debriefing. I got the time to ... 20 more minutes. Okay. How effective are the various tools used thus far; in particular, which are poorly suited for use in zero g? Did you find that you needed any tools other than those provided in the kits? Okay, yes, we've found that we'd like to have files, regular-type files, and drills are a couple of things that we'd like to have. I guess that the tools that we've used - I know we've had difficulty with some of them. I was just trying to - I was trying to remember the specifics involved.
022 12 11 14	PLT	One of the biggest problems we have is in managing the tools. And I end up carrying them in my pocket. The tool caddy is almost useless because it doesn't hold the tools. They just come out of it when you're - you try to put them in there and move, why they just scatter all over everything, come out. Things like putting all of the Alle - little hex, or Allen wrenches, you know - in a bag, where you have a bag with them. We're delighted to have the Allen wrenches or the hex wrenches, but see, when you open the top of the pocket, you know, then it gets - everything just comes floating right out in your face. And with it - it sounds like chimes ringing. And - that - that's a difficult task to handle and I'm sure that's -
Ref. 3.42		

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

030 16 30 07 Ref. 3.43	PLT	My shoes getting worse all the time. Just about tore my foot off.
030 16 30 10	CDR	Oh ... hush.
030 16 44 41	PLT	Okay, downling switch, position 7.
	CDR	Okay, there are scattered to broken clouds.
	CC	We're with you guys across the States. Probably got you about 15 minutes.
	PLT	Okay.
	CDR	Okay, Crip.
030 16 45 26	PLT	Okay, waiting for 46 even.
	CDR	Okay, Dillon Reservoir, if you can just kind of jump out and hit me right in the [illegible]
	CC	You might get wet that way.
	CDR	That's okay. At least I'll get the [illegible]
	PLT	Stand by for 46.
	CDR	Okay, that's the end of the nadir swath. I can start -
	PLT	Stand by -
030 16 46 00	PLT	MARK. SCAT, STANDBY. And -
030 16 46 02	PLT	MARK. RAD, STANDBY. 193 MODE, CROSSTRACK CONTIGUOUS. And ANGLE ROLL, plus 30. POLARIZATION, 1. Waiting for 46:30.
	CDR	Everybody's socked in up in the northwest.
	PLT	Stand by -
030 16 46 30	PLT	MARK. SCAT, ON and RAD, ON. 193 ALTIMETER MODE to 5; RANGE, 73; POLAR - Okay, that's that one. *** link, 7. And you might confirm our downlink switch position 7 if you would, Crip.

A-103

GIBSON As I recall, it was straightforward, no problems.

CARR Water System Gas Bleed:

POGUE Water system gas bleed, water sample, H_2O system flush, H_2O system bleed, WMCH activation: I didn't like the design. The procedures were well written. Everything was nominal except for the error on me. It was recoverable. All it did was cost me time.

CARR Triangle Shoe Distribution: I was very relieved to get them. I was tired of not being able to anchor myself properly to do anything.

GIBSON I think the triangle shoes are a perfectly adequate way of restraining yourself. The more grid you have available around a work station, the easier it's going to be. My only regret is that even though we had grid, the floor people had managed to bollix up at least 50 percent of the available triangles. I'd say at least that.

A-104

CARR I remember being impressed right at the outset with the triangles shoes. I wish we hadn't gone for hightops. I wished we'd gone for low-cuts. I never did lace my shoes to the top. I always laced to about two or three eyelets short of the top and tied the laces around my ankles. I would have much preferred low-cut shoes.

Ref. 3.45

GIBSON I did that, too. I did it to try to allow the calf muscles to get a little more exercise. Rather than have the ankle restrained with the hightops, sort of make them into a low-cut. We get more exercise in the legs. I think it would be an idea for the future. Those hightops, if anything, gave you support that you shouldn't have had.

CARR I'm sure that was the purpose of the hightop, ankle support, so you wouldn't hurt your ankles.

GIBSON Yes. The problem is that you want to work your ankles so you don't lose all that strength. You keep your legs in trim. That's one reason I tied them down a couple of eyelets. We should have had lowcuts instead of the hightops.

POGUE I like the hightops. I have weak ankles to start with. The point you're making is very good. There's no reason why we couldn't have had both. They don't weigh that much. I ended up breaking one of my shoes. It would have been nice to have a backup there.

CARR Yes, we should have had backup shoes.

GIBSON Foot-plates. All we had was a canvas cover. One evening I tried to put the toe-guards on mine. I spent 2-1/2 hours and nearly put the screwdriver through my palm a few times trying to get them on. I thought that was a poor way to go. We

GIBSON (CONT'D) should've had shoes that were right to begin with. Secondly, to change we should not have had to unscrew every little screw. There must have been about 20 screws in each. That was a real waste of in-orbit time.

Ref. 3.45

CARR I have to take a lot of the blame for that one. I was the one who bought off on bringing up new shoe tops. The choice was to bring out new shoe tops or nothing. The option was not open to take up a new set of shoes.

GIBSON From the amount of time and effort it really took inflight, it was a poor trade off.

CARR We were forced into taking shoe tops because of a weight consideration.

A-105

CARR IMSS Miscellaneous Medical Supply Transfer. That was very badly handled both by me as well as by the people on the ground. We should never have got ourselves into a situation where I had to open up those cans and start miscellaneous medical supply transfer on activation day. That was absolutely ridiculous. That should have been done many days later. It shouldn't have even been attempted in activation. We should have transferred only that which we felt would be possibly needed early. All of that foolishness of working with tubes of lidocaine and epinephrine was a gross waste of time in activation. We never

POGUE (CONT'D) and make sure that we were aware of those that applied to any part of that day's work. That is a management function that was not allowed for in postsleep activities.

Then we had urine sampling and drawer resupply. These are simple, straightforward tasks but they are time consuming. Toward the end, we were doing them within 10 minutes, but at the first, it was taking me approximately 20. We had to be careful to take your whole urine drawer out. We had the receptacle for the bag that we had to put in a position to measure the quantity. Then we had to sample it, get a new drawer and a new bag out, and suck it down to vacuum to make sure it didn't have air in it. Then we had to put it back in and reinsert it in the drawer. Then we were through. In the process, we almost always spilled a few drops of urine. What looks like a simple, one-line entry turns into a great complexity in total time management.

The BMMD required getting use to, and it took a little time.

A-106

The S233 could square wave the postsleep activity. The experiment only took 7 or 8 minutes, but we had to make sure we had a camera, took our pad, and got there in time to get dark adapted. We also had a remote device. If we didn't have time to get dressed then we wouldn't have the pencils in our pockets. All this added up to confusion if we were not thinking

POGUE (CONT'D) 1/2 hour about. We possibly had not eaten at this time or changed the urine drawer and we were already thinking about comet photographs.

We had to urinate before we did the S233. So, there are many serial tasks that made it not dovetail together. Later on in the mission, this started to fit in quite well. The S233, a comet photograph, could take 12 to 15 minutes. We had to make sure that the camera had the right type of film in it. There should have been one camera dedicated to S233 only and there was after some time. We did have occasions when the camera was downloaded, and there was confusions about it that did require attention. Most of the time, everything was all right but we still had to check it.

The early ATM work caused Ed problems. It usually did not affect us but we made sure that we worked around him the right way. The pad organization means getting the pads straight. We had to make sure we had the summary flight plan sent in the evening and all the supporting documentation sent the following morning. If we did that experiment twice, we had to make sure that we had them in the right order. Sometimes they were addressed to the wrong crewman. If I had a certain type of experiment, I may have had the maneuver pad for somebody else who was going to do the maneuver. This was not a simple, straightforward

Ref. 3.47

POGUE (CONT'D) management operation; it required attention and interpretation. And all this time we're supposed to be weighing ourselves, getting breakfast, talking to the ground and answering the questions, throwing valves and switches for them, going to the ATM console and back down, getting another drink of orange juice, talking to the ground again, and this was supposed to be a nice, relaxed postsleep activity. It turned out to be a chaotic operation some days.

In between all of this we were supposed to be reconstituting our food. Updates and corrections of pads started at breakfast time and continued through the day. We were also supposed to shave, comb hair, brush teeth, and do whatever else was listed on a standard format. We did this very rapidly.

A-107

GIBSON We just skipped it.

POGUE We didn't do it, that's right. We did get cameras in position at the wardroom window.

Ref. 3.48 Normally the first thing I do when I get up is I shower, shave, dress and then I go about my activities. We had to weigh in the EMMD in a standard configuration every day, unclothed. We did our first activities without shoes so we did have to wait until that was all done before we could get dressed. If I had to fit my film threading pad in with that, I ended up doing the film threading pad without my triangle shoes on, trying to save

POGUE (CONT'D) time so that I could fit myself in with the postsleep activity of the SPT and the CDR. That was difficult because I was barefooted doing the film threading pad. And, of course, 1 out of 3 days I'd have a loading problem with one of the transporters, and this would be time consuming. I will admit that after we organized, the film threading pad turned out to be much simpler. We were doing it in the evening.

I want to point out that what would appear to be a superficial type of complaint is not really that. I listed approximately 13 things that we were doing during that hour devoted to PSA in the morning.

CARR Okay, let's move on to experiments. Ed, talk about a typical day with the ATM.

GIBSON We're still talking about the first 28 days. Usually, I would be the first one there in the morning. I would try to get the pads organized and the numbers copied onto the cue cards, although that was not always the case. Sometimes Jer or Bill did it.

The first pass of day was usually devoted to a JOP 6, building block 1, and that was usually pretty straightforward. If you find yourself rushed from the PSA, you can get behind and start making mistakes. Again we are talking about the first 28 days. There were many mistakes made on the ATM in those first 28 days.

CARR (CONT'D) There were some areas where something was just not called a station 699, and it was really called a trash airlock. When you tell somebody to go to station 699, if he doesn't know what 699 is, he's got to go to a stowage book, research it, and find out what 699 is. If you'd have said, go to the trash airlock in your procedure, there would have been no question. There were several instances of that in procedures where we were directed to go to a certain station, and we didn't have the slightest idea what station it was, but we had a hunch. We'd go to the stowage book, find the number and, sure enough, it was a station or a location that was commonly known by a name rather than a number. I think our problem with stowage was that we worked so hard to make the listing computer compatible that we dehumanized stowage to a point that it sometimes caused us problems. We've got to be careful about that. Let's not let the computer system drive us to a point that we can't really relate to the human side.

A-108

Clothes: we've pretty well talked about clothes in M487. I think we were for the most part satisfied with the clothes.

Ref. 3.49

CARR (CONT'D) I think Bill indicated on one occasion that the zippers should have had pull tabs on them. Ed and I agreed with him 100 percent. Those zippers were sometimes hard to locate in your pockets. If there was a little pull tab, it would have been much easier to grasp.

POGUE On our brown shirts with the zipper pockets, I planned on using that zipper pocket for a number of items and I never did. The way clothes work up your carcass in zero gravity, that zipper pocket was actually almost over my shoulder. In the future, if you have a soft shirt like the brown shirt, something like a kangaroo pouch in it would be nice. My trousers all fit too big because I lost some weight before flight. It'd be nice to have A little more adjustment capability on waistband would be nice, because you also have visceral, shift in zero gravity.

CARR Yes, that's something that the medics ought to really work on with the clothes people. In zero g, a guy becomes more slender and grows taller, and those things ought to be taken into account in clothing design. I think here we have a legitimate slap in the chops for somebody, and I don't know who it is in the clothes area. All those neat little extra pockets that we had put on so that we could carry our little folder books around and our pens and scissors and all that stuff were not properly sized, and we were unable to use them in the manner

CARR (CONT'D) for which they were designed, and it was a great big pain in the neck. I think somebody really goofed on that one. We paid the price with inconvenience. I think that was a very bad deal. The flashlight would not fit in the flashlight pocket, the scissors would not fit in the scissors pocket, and the book would not fit in the book pocket.

GIBSON And the knife would not fit in the knife pocket.

CARR So you found yourself putting things wherever you could. I'm the kind of person who likes to put things in their place and have them there so that when I need them quickly I can just grab at them. If I can't always put my pencils in the same pocket or put my flashlight in the same pocket, some time when I need them, it will cost me extra time and thought process to locate my pen, pencil, or flashlight. And that's the kind of time you don't need to waste. You don't need to waste time looking for something in your pockets. You ought to know where each item is, and you ought to be able to get to it quickly so that you can do the important things without delay.

POGUE I mentioned this once, I think, and the counterargument was that the garment people had been given that requirement and they had made all the clothes that way and we were stuck with it. A suggestion for future design is that something like cowboy holsters be incorporated on both sides of the trousers so that

POGUE (CONT'D) you would have a receptacle for a zip-on pouch of some kind. This pouch could be made flat with little receptacles on it or that would incorporate whatever little pieces of hardware you wanted.

CARR In general, I would say that the clothes were good. I even wore the brown shirts near the end of the mission because they weren't quite as smelly as I had found them to be on the ground. I guess the main reason they weren't as smelly is because we didn't sweat as much up there.

GIBSON I personally liked the white shirts though. I didn't like the brown ones very much. They were a little hot and uncomfortable and itchy.

CARR A very pleasant feature that I found was the ability to zip on and zip off the legs of the trousers. I found that to be very pleasing and convenient, and whenever the weather was warm, I was quite comfortable in the short trousers.

POGUE One thing that would have made the trousers and the jackets nicer would have been if I could have gotten the legs on and off over the triangle shoes. It could be done but it was a problem. I liked the idea of having that sweat shirt fitting underneath. All my sleeves were too long. The over cover there was just a little bit too long and I ended up cutting

POGUE (CONT'D) those with scissors. I liked the idea of having that knit fitting on the arms and the legs but it would be nice to have a little more stretch.

Ref. 3.49

GIBSON I don't think we should let the clothing debriefing go by without mentioning that we all got a little tired of looking at brown. I sure would have liked to have seen some different colors up there. I know the problems you had with trying to make fireproof clothing and the problems of dying, but I hope that the effort doesn't stop. Brown surely is a tiresome color, and I think something in the order of blue and green would have been most welcomed. We ought to push for it in the future and not just live with the drab brown we lived with during Skylab.

A-110

CARR I think that's a very good point. I think that future clothing design ought to be rather colorful and it ought to be varied.

POGUE Crew Quarters: The only point that I'd like to make is about the sleep compartment. I'd still like to be able to adjust air flow from inside the sleeping bag.

CARR Yes. Another item that we discussed in a group and haven't put on tape yet is the idea that crew quarters ought to be more spread out. The three crew areas were so close together that if a crewman did have a loose bed and did do any thrashing at night, he bothered the other two crewmen. If a fellow wanted

GIBSON T003: I did that just about all the time in the pre- and post-sleep. Post-sleep I got it just about every morning, no problem. Pre-sleep, I occasionally missed it because it depended upon what I was doing. I just wasn't as organized at night time and on a couple of occasions I did miss it. The only other anomally was stowage; with the data card there was no problem.

POGUE One comment on T003 which applied to all the experiments in the checklist - It would not hurt to retain censored background data from these experiments in the checklist and to add sketches to show us the various locations that the PI wanted. Sometimes I was a little bit in doubt about getting exact locations.

CARR I guess the only area in T003 in which there was any doubt about what we were doing for them is in T003-7, the shower dressing and undressing bit. They wanted that done at the shower location. We did all our dressing and undressing in our sleep compartments. I never understood that and we alluded to that a little earlier. I don't think your shower data are worth a nickel. Instead of dressing and undressing data I gave data before and after our first shower. Maybe that will give you a little bit of information but I think

Ref. 3.50

CARR (CONT'D) Water dispensing was very well covered. As for containers, the spoonbowl was a disliked item and the conical pack was one of the more liked of the items.

GIBSON In order to increase the quality of food by including more frozen food on board, we should package three or four frozen foods in the same container, so they could be heated up together. This would minimize container space and volume for each individual item, frozen TV dinner style. If you know that you want mashed potatoes with your meat and peas, you could put it all in one big package, and heat it all together. This would simplify packaging and serving.

POGUE Garments and Personal Gear: All zippers should have little pull tabs on them. I believe in the kangaroo pouch for a shirt, rather than the little pocket on the chest because it works its way up to your shoulder. We don't have enough places to stow flashlights, pencils, scissors, or tools.

CARR Let me give you a word of caution. Bill says he likes the kangaroo pouch on the shirt. That doesn't mean that the shirts for the next mission should all have kangaroo pouches. The plea is for flexibility. If one guy likes kangaroo pouches, great. Give them to him. If another guy doesn't want kangaroo pouches, don't saddle him with them just because the crew of SL-4 said they like that type pocket.

Ref. 3.51

POGUE The point is we should not be adverse to trying new things.

CARR Right. But on the other hand, we don't want to saddle every one with the same thing.

GIBSON One thing I have never seen anybody use was the strips across the top which were snapped to hold comm cables. I found those things were always open, or in the way. We never used the comm cable holders in zero g, and I would eliminate them from future spacecraft.

CARR Personal Gear: It was great to always have scissors with you and I wish we'd had a better pocket to put them in. The Swiss army knife was an extremely valuable tool to all of us. It had enough flexibility that we used it on just about all of the appliances, at one time or another. That is a good piece of gear to have with you at all times, and should be properly stowed on the clothing.

CARR I want to mention the food arrangement. Bill had to climb over the table to reach his food. I had the best position, next to the window and the food. Bill had a good position, but the food was not accessible from all positions at the table.

18.2 SWS

CARR Crew Compartment Configuration: We have covered that in M487 debriefings.

Clothing and Related Equipment, Restraint Systems, Thermal Control, Tools, and Camera Equipment:

POGUE The only thing I want to mention here is my shoe that broke. It was the one thing that broke we didn't have a replacement for. We had numerous shirts, trousers, and everything else, but we didn't have any spare footplates or shoes.

Ref. 3.52

CARR We have debriefed everything in the SWS area except camera equipment.

POGUE In flight, we had many complaints about DACs. All the suggestions sent up by ground didn't help a bit. I'm sure the people working on this were working hard and had the best intentions, but their equipment was terrible. The DAC clawed film and ruined film. When we were threading the DACs, they would shove the film back into the supply reel. I felt ill at ease operating that. At first, I blamed myself for every mistake. In retrospect, I think I made very few errors. It was the equipment. You can't put the connectors on after you get a transporter on and little things like that which were constant irritations. The ground was saying that the constant

A-112

CARR [illegible] was very good. The ergometer was great for the cardiovascular system; the treadmill was great for one-g muscles. The Mark I and the Mark II were real good for your other muscles. We did not use the Mark III. Muscle soreness during or after flight - None of us complained of any significant muscle soreness during the flight. After the flight, none of us really complained much of muscle soreness until we began running. Bill and I had a bad complaint with the muscles in the front part of our legs. Those were the muscles that bugged us. Bi, I guess your complaints have been more [illegible] the joints. Perspiration during nonexercise periods was essentially nonexistent. During exercise, all three of us perspired.

Ref. 3.53

POGUE You know, there is an argument to be made for disposable paper sweatshirts.

GIBSON One of the problems encountered when working on the ergometer was that a layer of water built up on the body. I used to build up just a sheet of water across the back. You could really get some pretty big balls of water coming off of that, if you moved yourself around.

CARR Inflight Oral Hygiene: Mouth discomfort -

POGUE A little bit of bad breath.

QUERY No, that's a good lesson; we might just as well face up to that.

CARR That's right. If something is going to stick out all more a nice handhold, it's going to be used for a handhold.

QUERY Particularly when there's not any other type of handhold?

CARR That's right.

QUERY From what has been said, we've concluded that the triangles and the grid form one of the best foot restraints we've run across.

GIBSON They are good. We found that we could work those easily and it allows a lot of flexibility.

A-113

POGUE We only had one pair of shoes, actually. I wanted to use those conical shoes more but you couldn't use them with the bicycle. But for general purposes, the triangle worked fine.

Ref. 3.54

CARR It's so nice to be able to put your foot in and have it in and not have to hold it in. That was one of the [illegible] advantages of a mushroom. Once you put that foot in there, you had to keep the pressure to hold it in the corner or it would drift out and you might, when you're busy with something else, find yourself floating off. Then you would have to stop what you were doing and reanchor. But there are things to be said for a type of restraint which allows you to quickly get in and get out. It would be nice to be able to swap foot restraints or swap the type of shoes you wear. As for the shoe itself, Ed and I wished that those shoes had been low tops instead of high tops. We didn't feel that our ankles were in any danger at all and it would have been better. Bill liked the high tops.

POGUE Still, I would have gotten along just as well with the low shoes and there would be less effort lacing them up every time.

CARR Well, laces could have been done away with too.

POGUE That's right; we don't need laces.

QUERY Mechanically the shoes were not ideal?

POGUE One of them broke.

QUERY Did that limit you to one-foot operation, Bill, when you damaged that shoe?

POGUE No, I fixed it.

GIBSON With enough gray tape you can fix anything.

POGUE It looked like I had a baseball taped on the bottom on my shoe because I put so much tape on it, but it worked all right.

Ref. 3.54

GIBSON The only disadvantage for me was that I hated something massive on the end of my feet, and those triangles were fairly massive. But when I wanted to do any work at all, I just had to put the triangles. There was no way around it.

A-114

CARR Once we got the suits on in the pre and post EVA, we sure missed those triangles.

POGUE The IVA crewman really had a time at the ATM grid. I was continually working to hold myself in position when I was suited.

QUERY That's very interesting because Orbiter and Spacelab are both at a position now where we must baseline some sort

CARR (CONT'D) enough. The low humidity, I think, made the high temperatures in the high beta case more tolerable for us. As for the showers, the chief noticeable effect was some condensation.

GIBSON I did not notice a rise in humidity on days that we showered.

POGUE One of the things that bothered me was the excessive temperature differences between the MDA and the workshop. It was always too cool in the MDA and often hot in the workshop. There seemed to be no way to equalize the temperatures.

Ref. 3.55

QUERY Ed, at one point you mentioned you had eaten a meal at the ATM panel. Did you take a tray up there?

GIBSON I ate a number of meals up there.

QUERY Was that difficult at all?

GIBSON I often took segments of meals up there. No, it was no problem at all. We had the large pockets in which I would usually take up three or four cans of whatever was heated and two or three juices and go at them one by one. That was no problem at all.

CARR (CONT'D): pleasant to have your food open and to be able to eat from it, rather than having to open and close a lot of containers.

GIBSON: We found that the table was a little bit low, as he said, but it was still preferable to be able to get everything organized, opened up, and proceed into the meal the same as you would down here. However, sometimes I preferred to pick up one can at a time, rather than trying to eat it out of a tray. Another general ground rule in the design of containers which interface with fluids is to avoid elastic materials. By elastic, I mean the very thin membrane over the filet that when cut would cause fluid spill. Containers with elasticity, when interfaced with liquids, tend to pump out food particles and liquid if not handled very carefully. The spoon bowls containing soup are an example of this.

A-115

CARR: We had a quality control problem in that the little loop that your finger went through would break off, it would separate right at the weld or whatever you call it in plastics.

QUERY: Let's examine a few comments concerning garments to see if you think they are reasonable assumptions. The two-piece garments ought to be baselined as a standard zero g wearing apparel because of the convenience of waste management and

Ref 3.56

QUERY (CONT'D): adjusting to various thermal situations. Elastic cuffs are not required. Protective headgear is probably not required IVA. Pockets are probably one of the most useful design features and ought to be fully thought out, well designed. Are those reasonable statements?

CARR: Don't forget zipper pulls. I don't know if I agree that elastic cuffs are not necessary. They sure keep your trousers from riding up on your leg. The problem is elastic cuffs can make it difficult to put a foot through a pant leg with a sh[illegible]

[illegible]: We were under the [illegible] that there was not [illegible] arms and legs to ride up. Do they?

CARR: I felt that they rode up a little bit on me.

POGUE: I didn't have any trouble with them myself.

[illegible]: The ones we had I think worked real well. I like the elastic on the arms [illegible]. I like to pull up the arms and that way they'd stay up.

[illegible]: That's going to be a pretty individual thing.

QUERY: You think it would be difficult to design a standard garment?

CARR — I think it will be, because of individual preferences.

QUERY — Did you cycle all of the garments through a period of use as cleaning rags, or were only certain ones suitable for that kind of use?

CARR — Only certain ones. We didn't bother to use any of the brown stuff for cleaning, but all the cotton material was very handy for cleaning.

GIBSON — I used old clothes for light baffles also. I had them wadded up and packed in the area between the two floors because the lights from the OWS came into my sleep compartment.

QUERY — We did a certain amount of counting in terms of what you recorded for us that you threw away. We decided that some of you threw away more things than you started with.

POGUE — That's correct.

QUERY — Was there an interchangeability between crewmen or were there leftovers from ealier missions?

CARR — There were leftovers.

POGUE — When I had the problem with rash on my back, I broke out a set of Jack Lousma's clothes. I was changing shirts

Ref. 3.56

POGUE (CONT'D) — every day. They weren't too baggy because clothing rides up in zero gravity anyway.

QUERY — Did your height expansion have any noticeable effect on the fit of your garments through the course of the mission?

CARR — That may be why I was getting the ride-up effect on the legs. I would move my legs and my trousers would ride up on me and when I would straighten my leg the trouser was still high. So I noticed that frequently I would kick my leg in order to throw my trousers down a little further.

GIBSON — I noticed the EVA suit was a lot tighter.

QUERY — Did you find much use for the IVA gloves in handling rods and things at the SAL?

CARR — Never used them.

POGUE — I sure could have used some work gloves in many places.

GIBSON — We found those gloves just before we left, remember?

CARR — Yes, in the little valet up there.

GIBSON I did use those gloves when we were having the problems with the urine return container and the trays. That involved handling those things quite a bit, and without those gloves it would have really been hard to do.

Ref. 3.56

QUERY Did you ever use the bump hats? We didn't hear any comments on it.

CARR Only with M509 and T020.

POGUE Yes, it was called out for when we went down in the scuppers, down in the plenum; there was no need to use it. I just put the headlamp on or carried a flashlight in my mouth.

A-117

GIBSON Individual crew acrobatics might have been a good place to use it because if you were ever going to hit your head on anything, that was the time.

QUERY In the realm of off-duty activities, we notice that a lot more use was made of looking out the window and enjoying the freedom of zero g;than some of the specific provisions that were put on board for off duty.

CARR We never played a game of cards the whole time we were up there. Darts, we never used.

GIBSON Yes, but you have to be cautioned, though. Many days when measurements were taken we did not all eat together. So they might be sequential. We would take one before anyone started in there and then maybe after the first guy ate or the second guy, whoever was responsible for that experiment.

QUERY You did take a measurement in the waste management compartment before and after, also?

GIBSON Yes, that was only a couple of times, as I recall. We did miss a couple of those measurements from time to time and I apologize for that, but most of the time they were taken as specified.

A-118

CARR We couldn't understand the reason for the shower readings. You wanted them before and after removal of clothing, and you wanted it done at the shower position, but most

Ref. 3.58 of us took our clothes off in another area.

QUERY In the sleep compartment; I understand.

CARR We weren't sure exactly what it is you wanted to to get. When you get in a sleep compartment and start taking off your clothes and start rustling the beds around, you're going to get skin particles and hair out of the beds into your analyzer, which would have affected your data. The

CARR (CONT'D) first two shower measurements that I did, I gave you a reading in position before the shower and a reading after the shower.

QUERY The intent was to take a measurement before doffing your clothes. This was orginally intended to be taken in the forward dome area at the doffing and donning station.

GIBSON I don't recall being briefed on T003. It would have helped to have understood some of these objectives.

POGUE It would have helped us to have had either amplification in the checklist on the precise locations of the stations or to have had a drawing of the workshop showing where it was you wanted those. Sometimes it wasn't too clear.

QUERY Right, I understand that.

QUERY Okay, any other questions on the T003 from anyone?

GIBSON I'd like to ask a question about the holes that were left along the side when this thing had to be pried off the mounting plate. I put tape over that, because I didn't know whether that was another source of air inlet. Did that negate the data?

QUERY I'm sorry; you put the tape over what?

CARR And we were prepared to change out the probe on the urine dump system, but it - it cleared so we didn't have to go through with that.

QUERY Any problem encountered with static discharge? You talked about it being so dry.

CARR Surprisingly enough, there was no static discharge.

QUERY We haven't had any report previously.

POGUE The only time that you got any indication of electro-statics was when we took off our shirts, you could feel the hair standing up on your arms, but I never heard any crackling.

Ref. 3.59

A-119

CARR No popping or cracking or anything, but you could sure make your hair on your arms stand up and on your head as you pulled the shirt over the top, your hair would just go right up sometimes.

QUERY Was the OWS thermal control system ever checked out? It's on reference system checklist sheet 9 through 18. Did you ever - do you recall that you ever checked out the thermal control system?

POGUE I don't recall. And if it's not - if it wasn't in the checkout and activation - -

POGUE Yes. Yes, I do. Panel 217.

CARR Oh, yes.

POGUE Yeah. If you could see your hands - All you got to do is just take a picture. I should have taken a picture of my hands after I got through doing the servicing in there, because there's no way of working in there - Well, I could use work gloves, I guess; I should have used work gloves. I used the photo gloves. But that should have been caught by ground safety, that's so bad. There wasn't enough room in there to make then - to make and break those QDs for the liquid gas separator. It was just a sorry place to work; there's just no two ways about it.

Ref. 3.60

CARR The stowage in general - The biggest single problem with stowage is retention in the zero-g situation. We need to do a lot of thinking and get some inventiveness brought to play here on how to retain things - little things. Of course, the film vault is a prime example of that. But some of those big film vaults up in the MDA were just great big empty boxes, and it got to the point where you just pushed something in there and closed the door real quick. And then you knew the next time you had to open the door, you had to be on your guard. And little things

QUERY Okay. We have Dick Heckman from Marshall and Hoot Gibson, of course you know, from JSC. ..., you have some more questions you want to take care of ...?

QUERY Yes. I'll - I'll cover the crew provision - equipment first. The cuffs on the Skylab jackets - Do you all consider them necessary or they're just a luxury?

CARR You mean the knitted cuffs?

QUERY Yes.

CARR Yes, no.

(Laughter)

POGUE Now, wait a minute, now. I like - I didn't like the - the overcuffs. And the knitted cuff was too tight for me to get my watch through; that's the reason I didn't like it. I liked the idea. It just turned out, on my - -

QUERY ... too tight.

POGUE - - particular jacket, I ended up cutting - taking scissors and cutting the solid overcuffs. You know what I'm talking about?

QUERY Yes.

POG

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Ref. 3.61

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POGUE And then the sweat shirt knitted-cuff-type underneath, bothered me a little bit because of the - of the watch.

CARR I don't think that's something you really need to legislate. That's kind of personal preference. I know if you've got - got the capability of putting them in the design, just ask the crewman what he wants.

QUERY Okay ...

CARR But I - I liked them. It kept the sleeves from riding up too much on me and the trouser legs from riding up, and so I liked them. But these guys found them to be somewhat of a hindrance.

POGUE I was more put out with them on the trousers than I was on the sleeves of the jackets, because I couldn't take my trousers off without taking my shoes off, you know, undressing for PT.

CARR But let's face it. If you do them, somebody's going to bitch; if you take them off, somebody's going to bitch.

QUERY The other crews - the other crews took them off.

CARR Yes.

QUERY Right.

POGUE - - and they were frayed.

CARR They were a real bother too.

POGUE Yes, that's - -

CARR We'd have been better off with Mosite inserts.

QUERY The - Did you have much trouble with the snap - velcro or decals that were bonded in wording off?

CARR Yes, we sure did. We had a lot of them come off, and finally by the time SL-4 came around, Kenny Kleinknecht and people had beat the system down to the point where they let us take some glue up with us. And we managed to glue some of them back, and they held very nicely.

A-121

QUERY Okay, habitability, and generally, you covered a lot of this with M487. We've got a few general comments we'd like to ask you to consider. What changes in general acceptability of your surroundings did you notice over the - Any particular things

CARR Well, one of the things is color. We got tired of the colors up there. There wasn't much variation, and our clothing was all the same color, and the walls were all

Ref. 3.62

QUERY Was there anything that you would have liked to change periodically? Or had the ability to change, just to alter?

CARR Let's see.

POGUE General area of habitability you're talking about now?

QUERY Yes. Provide more variation perhaps.

Ref. 3.63

POGUE Well, I can't think of anything right off.

CARR The color changes would have helped, you know; if you'd have had maybe variations in color of clothing we - you could - -

POGUE Well, I tell you; in a general area what we really would have liked - and it's not really the question you're asking, but it answers - it satisfies the requirement, and that is television for entertainment - and more tapes. That sort of thing. That's what satisfied that sort of craving for variety.

CARR Yes. The single best sorts of entertainment we had up there, as we've mentioned many times, was looking out the window. And that was constantly changing and it was very, very interesting to us.